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BIOSYSTEMATICS OF THE GENUS *DICROTENDIPES* KIEFFER, 1913 (DIPTERA: CHIRONOMIDAE: CHIRONOMINAE) OF THE WORLD

BY

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ABSTRACT — The taxonomy, zoogeography and phylogeny of the genus *Dicrotendipes* Kieffer, 1913 (Diptera: Chironomidae) are reviewed on a world-wide basis. Data from a previous study of the Nearctic fauna (Epler 1983, 1987a) are supplemented by studies of the Holarctic, Neotropical, Afrotropical, Oriental, Australian and Oceanian faunas. Seventy-two species names are recognized; the type-species of the genus is *Chironomus septemmaculatus* Becker, 1908.

Notes on the Holarctic fauna are provided; 25 species are recognized from the area. *Dicrotendipes incurvus* (Sublette, 1964) is considered a junior synonym of *D. tritomus* (Kieffer, 1916). Keys for the adult males, pupae and larvae of the *Dicrotendipes* of the Holarctic region are included.

The taxonomy of 14 species recognized from the Afrotropical region is reviewed; these are: *D. bredoi* (Goetghebuer, 1936), *D. chambiensis* (Goetghebuer, 1936), *D. collarti* (Goetghebuer, 1936), *D. cordatus* Kieffer, 1922, *D. ealae* (Freeman, 1957), *D. freemani* [nom. nov. for *D. binotatus* (Kieffer, 1911)], *D. fusconotatus* (Kieffer, 1922), *D. kribiicola* (Kieffer, 1923), *D. leucolabis* Kieffer, 1922, *D. nigrolineatus* (Freeman, 1957), *D. peringueyanus* Kieffer, 1924, *D. schoutedeni* (Goetghebuer, 1936), *D. septemmaculatus* (Becker, 1908) and *D. sudanicus* (Freeman, 1957). The larvae and pupae of *D. fusconotatus, D. kribiicola, D. septemmaculatus* and *D. sudanicus,* and the pupa of *D. cordatus* are described. New junior synonyms for *D. septemmaculatus* are: *D. formosanus* Kieffer, 1916, *D. frontalis* Kieffer, 1916, *Chironomus hirtitarsis* Johannsen, 1932, and *D. rajasthani* Singh & Kulshrestha, 1977; *Ch. punctatipennis* Kieffer, 1910 is considered a probable junior synonym. A key to adult males is provided.

Nineteen species are recorded from the Neotropical region. Previously described species discussed include: *D. aethiops* (Townes, 1945), *D. alsinensis* (Paggi, 1975), *D. californicus* (Johannsen, 1905), *D. crypticus* Epler, 1987, *D. embalsensis* Paggi, 1987, *D. nestori* Paggi, 1978, *D.*

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obrienorum Epler, 1987, *D. pellegriniensis* Paggi, 1987 and *D. sinoposus* Epler, 1987. The adult males of 10 new species are described: *D. amazonicus, D. dasylabidus, D. demissus, D. fittkaui, D. palearivillosus, D. paradasylabidus, D. paterjohni, D. radinovskyi, D. reissi* and *D. soccus;* adult females are described for *D. amazonicus* and *D. demissus;* and pupae are described for *D. fittkaui* and *D. reissi.* A key is provided to identify Neotropical adult males.

A total of 19 species are recognized from the combined Oriental, Australian and Oceanian regions. Three species previously considered to be *Dicrotendipes* are removed: *Ch. blandellus* Kieffer, 1906, *D. paxillus* Guha, Chaudhuri & Nandi, 1982, and *D. socionotus* Guha, Chaudhuri & Nandi, 1982. New species and stages described are: *D. balciunasi* (adult male), *D. cumberlandensis* (adult male and female, pupa, larva), *D. jobetus* (adult male), *D. jonmartini* (adult male, pupa, larva), *D. lindae* (adult male), *D. pseudoconjunctus* (adult male, pupa, larva) and *D. sarinae* (adult male and female, pupa, larva). The adult males and females are redescribed, and pupae and larvae described, for: *D. candidibasis* (Edwards, 1924), *D. conjunctus* (Walker, 1856) and *D. pelochloris* (Kieffer, 1912); adult males are redescribed for *D. bilobatus* Kieffer, 1917 and *D. tenuiforceps* (Kieffer, 1913). The pupa and larva of *D. flexus* (Johannsen, 1932) are redescribed, and the taxonomy of *D. leei* (Freeman, 1961) and *D. taylori* (Freeman, 1961) is reviewed; *D. semiviridis* is considered a *species inquirenda.* New synonyms include: *Ch. melanocnemis* Edwards, 1928 (junior synonym of *D. candidibasis); Limnochironomus niveicauda* Kieffer, 1921, *Ch. inferior* Johannsen, 1932, *Ch.* (*D.*) *wirthi* Freeman, 1961, *Xenochironomus loripes* Guha & Chaudhuri, 1981, *Kimius hoonsooi* Ree, 1981 (junior synonyms of *D. pelochloris*) and *Ch.* (*D.*) *innisfailensis* Freeman, 1961 (junior synonym of *D. tenuiforceps*); *D. bilobatus* is removed from synonymy with *D. conjunctus.* Keys are provided for adult males, pupae and larvae.

Distributions of selected species are discussed and distribution maps provided for *D. aethiops, D. californicus* complex, *D. flexus, D. lobiger, D. modestus, D. nervosus, D. pelochloris, D. septemmaculatus, D. sinoposus, D. tenuiforceps* and *D. tritomus.*

The phylogeny of *Dicrotendipes* species known in all 3 life stages is analyzed cladistically. Results indicate that 3 major lineages occur within the genus, with at least 9 species groups.

Chapter I.
Introduction and Notes on The Holarctic *Dicrotendipes*

The genus *Dicrotendipes* was recently revised for the Nearctic region (Epler 1987a). This monograph is basically a continuation of that revision, and includes general notes on the genus and the Holarctic species (Chapter I), a review of the Afrotropical species (Chapter II), a revision of the Neotropical species (Chapter III), and a revision of the species found in the combined Oriental, Australasian and Oceanian region (termed the Oriental-Australasian region in this paper) (Chapter IV). The zoogeography of selected species in the genus is discussed in Chapter V. A phylogenetic analysis is included in Chapter VI. Appendix 1 is a list of the recognized species (72) in the genus; Appendix 2 presents a list of the most recent synonymies in the genus.

Methodology

Methods used for specimen preparation and measurement are similar to those explained in Epler (1983, 1987a, 1987b). Most measurement methods are illustrated in Figs. 1–5. All measurements are in micrometers (μm) (unless stated otherwise) and consist of the range, mean, and, in parentheses, the number of specimens utilized if different from the number (n) cited at the beginning of the description.

All illustrations were drawn by the author. The hypopygial figures are drawn to show a ventral and internal view (of apodemes) on the left, and a dorsal view to the right. Lateral aspects of hypopygia are drawn with the gonocoxae and gonostyli removed. The dorsal hypopygial figures are drawn with the sensilla chaetica of the superior volsella as they may appear when viewed with a compound microscope, i.e., dorsal. In actuality the sensilla chaetica of the superior volsella are generally ventral (Fig. 3A).

Specimens examined in this study were borrowed from various individuals and/or institutions. The following abbreviations are used to denote collections from which material was borrowed or in which type material will be placed:

AN — Australian National Insect Collection, CSIRO, Canberra, Australia (D.H. Colless).
BM — British Museum (Natural History), London, England, U.K. (P.S. Cranston).
CU — Clemson University, Clemson, SC, U.S.A. (M.W. Heyn).
FS — Florida State Collection of Arthropods, Florida A & M University, Tallahassee, FL, U.S.A.
HH — H. Hashimoto, Shizuoka University, Shizuoka, Japan.
IL — Instituto de Limnologia, Universidad Nacional de la Plata, Berisso, Argentina (A.C. Paggi).
IN — Instituto Nacional de Pesquisas da Amazônia, Manaus, Brazil.
IP — Institut für Pflanzenschutzforschung Kleinmachnow, Eberswalde-Finow, D.D.R (H.J. Müller).
JB — J. Balciunas, Fort Lauderdale, FL, U.S.A.
JE — J.H. Epler, Florida A & M University, Tallahassee, FL, U.S.A.
JM — J. Martin, University of Melbourne, Melbourne, Australia.
KM — Koninklijk Museum voor Midden-Afrika, Tervuren, Belgium (E. DeConinck).
LH — L. Hare, Université du Quebec, Quebec, Canada.
NM — Naturhistorisches Museum, Vienna, Austria (R. Contreras-Lichtenberg).
SP — School of Public Health and Tropical Medicine, University of Sydney, Sydney, Australia (M.L. Debenham).

UB — University of Burdwan, Burdwan, India (P.K. Chaudhuri).
US — United States National Museum, Washington, D.C., U.S.A. (B.V. Peterson).
ZH — Zoologisches Museum, Humboldt University, Berlin, F.R.G (through P.S. Cranston).
ZM — Z.Moubayed, Université Paul Sabatier, Toulouse, France.
ZS — Zoologische Staatssammlung, Munich, F.R.G (E.J. Fittkau & F. Reiss).

Terminology and Morphology

Terminology and abbreviations for body parts and ratios follow Saether (1980) and Epler (1987a, 1987b), and are illustrated in Figs. 1–7. LWR refers to the length/width ratio of the superior volsella. See Epler (1987a) for a more detailed discussion of the morphology of *Dicrotendipes.* Some new terms are introduced here.

If setae present on the dorsum of the hypopygium (adult male) could not be distinguished as medial and/or dorsal basal setae, the combined term *dorsomedial setae* was used.

Freeman (1957:366) noted the presence of "5–6 black spines ventrally" on abdominal sternite VI of *D. cordatus* Kieffer. Epler (1987a) also noted the presence of "darker, flattened, bluntly tipped setae, which are easily lost" on most Nearctic species. Epler (1987b) referred to these setae as "flattened setae on S VI." Throughout the present monograph these setae, which are an apparent autapomorphy for *Dicrotendipes,* are termed *ventral accessory setae.* Although they are most often found on S VI, ventral accessory setae may also occur on S V and S VII, and are present on males and females of most species in the genus. They are absent from members of the *D. californicus* complex and the *septemmaculatus* group. Ventral accessory setae may appear as darker, more robust setae, as slightly flattened, darker and more robust setae, or as darker, stout spine-like setae (Fig. 1F).

I was mistaken in my Nearctic revision (Epler 1987a) when I stated that the large subquadrate to oval areas on the frontoclypeal apotome of *D. lobiger* (Kieffer) and the frontal apotome of *D. leucoscelis* (Townes) were dorsal (on the apotome). These areas are ventral (on the apotome) or internal. Similar areas are found on the larval frontal apotomes of *D. kribiicola* (Kieffer), *D. notatus* (Meigen), *D. conjunctus* (Walker) and its close relatives, and *D. pelochloris* (Kieffer).

Biology

Adults of *Dicrotendipes* have been considered as pests due to large emergences (Frommer & Rauch 1971; Ali & Mulla 1980), and have been implicated in allergic reactions in humans in Africa (Cranston et al. 1983).

The immature stages are found in both lentic and lotic habitats, but are generally more prevalent in lentic situations. The larvae in general are not "burrowers" as listed in Coffman & Ferrington (1984), but would be better classified as "clingers" and/or "sprawlers." Although often reported in the literature as "bottom-dwelling" (Roback 1957) or "epibenthic, unattached" (Beck 1977), the majority of *Dicrotendipes* larvae are found on the surface of aquatic vegetation, and among or on vegetation or Aufwuchs on rocks, logs, or similar substrata. The larvae construct silken tubes which are attached to the substrate. The pupal stage is also spent in the tube. I have rarely collected *Dicrotendipes* larvae from bottom mud, although larvae do occur commonly in algal mats on the bottom. Darby (1962) reported finding *D. californicus* (Johannsen) larvae on the surface of bottom mud in late May and early June in California, but found that as submerged vegetation increased, the vegetation became the favored habitat. Lenz (1954–1962) reported *Dicrotendipes* larvae (as *Limnochironomus*) as predominantly littoral and living on rocks, plant stems, and among aquatic vegetation, but also noted their existence in benthic detritus in water 10 m or more in depth, as well as among mosses and other vegetation on rocks in flowing water. I have found *D. fumidus* (Johannsen) on *Myriophyllum* and algae covered rocks, *D. lobus* (Beck) associated with *Najas, Juncus* and *Spartina* in salt marshes and *D. modestus* (Say) on *Myriophyllum* and *Typha;* and I have examined reared *D. candidibasis* (Edwards) specimens collected from streamside vegetation in Fiji and *D. septemmaculatus* larvae collected on *Hydrilla* from Burma, Indonesia and Malaysia. Edward (1964) found the larvae of *D. conjunctus* inhabiting "algal mats and slime." I have collected *D. crypticus* Epler larvae from vegetation on rocks in the swiftly flowing portions of a New Mexican creek; I have scraped *D. neomodestus* (Malloch) larvae from algae in sheets of water flowing over a dam in Pennsylvania, and have collected the apparent larva of *D. adnilus* Epler from periphyton from midstream rocks in the mountains of southeastern Arizona (Epler 1987a).

Hudson (1987:table 1) listed chironomid genera that have species with unusual larval habitats or life histories. Among the 9 unusual habitats were listed 2 in which *Dicrotendipes* larvae may be found. The first of these categories is "symbiotic." Disney (1975) found *D. peringueyanus* Kieffer living phoretically on the African river crabs *Potomonautes africanus* (A. Milne-Edwards) and *P. pobeguini* (Rathbun) in Cameroon. The second unusual larval habitat is "water held in plants." Epler (1987a) examined a *D. leucoscelis* larva which had been collected and reared from the water in a bromeliad from Florida. At least 4 species (*D. inouei* Hashimoto, *D. lobus* (Beck), *D. modestus* (Say) & *D. pallidicornis* (Goetghebuer)) occur in brackish water; 2 of which, *D. inouei* and *D. lobus,* apparently occur exclusively in brackish water. The larvae of *D. flexus* and *D. pelochloris* (as *inferior*) have been reported from hot springs (40°) from Sumatra (Lenz 1937).

Dicrotendipes larvae feed on algae, detritus, or the microorganisms associated with it. Lenz (1954–1962) reported that he observed larvae spinning small "catch-nets" within their tubes. By undulating their bodies, the larvae produced a current which forced water through the catch-net. After a period of time, the catch-net and its catch of detritus and microorganisms were consumed by the larvae. I have not observed feeding in *Dicrotendipes,* but many larval guts I've examined were packed with algae and detrital material. The larval undulations probably serve a respiratory function, introducing fresh water in the larval tube. I have also observed pupae undulating in their tubes.

Taxonomy

Kieffer (1913b:23) established the genus *Dicrotendipes* from African material, stating (my translation) "this genus differs from all others in that the inferior appendages of the male forceps are bifurcated." Only one species, *D. pictipennis,* was included, which by monotypy (International Code of Zoological Nomenclature (ICZN), Art. 68(d)) was the type-species for the genus. When Freeman (1957) relegated *Dicrotendipes* to subgeneric status within *Chironomus,* the epithet *pictipennis* became a junior secondary homonym of *Ch. pictipennis* Philippi, 1865. The next available name for this species was *quatuordecimpunctatum* Goetghebuer, originally described in *Polypedilum* by Goetghebuer (1936). Freeman (1957) considered *quatuordecimpunctatum* a subspecies of *D. pilosimanus* Kieffer, 1914; thus, *D. pilosimanus* became the type-species of *Dicrotendipes.* Although *Dicrotendipes* was later returned to full generic status (Hamilton et al. 1969), the name *D. pictipennis* was invalid under ICZN Art. 59(b), because it was a junior secondary homonym replaced before 1961. Cranston and Armitage (1988) rediscovered the holotype of *Chironomus septemmaculatus* Becker, 1908, and considered it to be a senior synonym of *D. pilosimanus* Kieffer, 1914. The correct name for the type-species of the genus is now *Ch. septemmaculatus* Becker.

The genus *Limnochironomus* was established from the Palaearctic by Kieffer (1920:166), who described the apex of the inferior volsella (appendage) as "sometimes simple, sometimes imperfectly bi- or trilobed." Several species were included. The type-species, by original designation, is *Tendipes falciformis* Kieffer, 1912. This species is a junior synonym of *Chironomus nervosus* Staeger, 1839.

Kieffer (1922) later described 3 more species in *Dicrotendipes: trilabis, cordatus,* and *leucolabis.* In his description of the inferior volsella of *D. cordatus,* Kieffer (1922:65) stated "the apex strongly broadened like a heart,

the 2 lobes not as long as wide, divided by a curved indentation." By including *cordatus* in *Dicrotendipes,* Kieffer expanded the concept of the genus. In the other species of *Dicrotendipes* he described, the apex of the inferior volsella is deeply bifid. However, the cordiform apex of the inferior volsella of *D. cordatus* would also fit the description of the same structure in *Limnochironomus,* as can be seen from Kieffer's figure (Kieffer 1922:fig. 66). My examination of the pupa of *D. cordatus* (see Chapter II) indicates that Kieffer was correct in including the species in *Dicrotendipes.*

Calochironomus was first mentioned by Kieffer (1921a) in a key to genera. No species were mentioned. In a later paper on African chironomids (Kieffer 1922:66), he included 6 species in the genus and designated the type-species as *fusconotatum,* which was described from a female.

Kieffer (1921b:590) established the genus *Carteria* based on material from the Philippines and Formosa, naming *Chironomus longilobus* (Kieffer, 1916) (originally described in *Tendipes*), as the type-species. However, *Carteria* was preoccupied by *Carteria* Diesing, 1866 (a protozoan), and was renamed *Carteronica* by Strand (1928).

Edwards' (1929) concept of *Chironomus* was much broader than that of the continental European workers (e.g. Thienemann) at that time. He did not consider *Limnochironomus* distinctive enough to rate subgeneric rank, but relegated it to his Group C of *Chironomus.*

Goetghebuer (1936, 1937–1954) also defined *Chironomus* in a broad sense. He considered *Carteria, Calochironomus, Dicrotendipes* and *Limnochironomus* to be subgenera of *Chironomus.* He apparently was unaware of Strand's 1928 paper renaming *Carteria* as *Carteronica.*

Aristovskaya (1935:114) established the genus *Sernowia* in a footnote, stating (loosely translated): "name at present for form previously described by N.N. Lipina as Chironominae genuinae No. 6." However, no type-species was designated. Pankratova's subsequent listing (in Chernovskii 1949) of Chironominae genuinae No. 6 and *Sernowia* (as *Sernovia*) as synonyms of *Limnochironomus* ex gr. *nervosus* Staeger does not satisfy the requirements for designation of a type-species (ICZN Art. 69). The name *Sernowia* thus becomes a *nomen nudum* and is not available (ICZN Art, 13(b)). *Sernowia* is also misspelled as "*Sernorwia*" in a table (Aristovskaya 1935:118).

Lenz (1937:6) described the larva and pupa of *Chironomus* (*Limnochironomus*) *flexus* Johannsen, 1932, and established it as a new genus, *Limnotendipes.* By monotypy, the type-species was *flexus.*

Cladotendipes was established by Lenz (1937) for a single species, *Chironomus inferior* Johannsen, 1932. Sublette and Sublette (1973) placed *Ch. inferior* in *Dicrotendipes,* but made no mention of *Cladotendipes.* See also Ashe (1983).

Townes (1945), in his comprehensive monograph of the Nearctic Chironomini (as Tendipedini), kept *Limnochironomus* as a subgenus of *Tendipes* (= *Chironomus*), and considered *Limnotendipes* a junior synonym.

Freeman (1955a) synonymized *Calochironomus* and *Limnochironomus* with *Dicrotendipes.* The type-species of *Calochironomus,* now known as *D. fusconotatus,* was described from a female. The male, apparently associated with the female by the pattern of wing spots and banded legs, has an inferior volsella with a deeply bifid apex, and is a *Dicrotendipes* in the sense of Kieffer's (1913b) original description of the genus. My examination of the immature stages (Chapter II) confirms this. Freeman also noted that the only species of *Calochironomus* in which the male was known to Kieffer, *C. oxylabis* Kieffer, 1922, was quite unlike the other species in the genus and was a *Chironomus* (*Einfeldia*). This species is now considered a junior synonym of *Chironomus formosipennis* Kieffer, 1908 (Freeman 1957; Freeman and Cranston 1980). Freeman (1955a) considered *Limnochironomus* a synonym of *Dicrotendipes* mainly because when Kieffer (1922) expanded the concept of *Dicrotendipes* by including *D. cordatus,* a species with a codiform apex to its inferior volsella, there was no longer a difference between the 2 genera. By Kieffer's (1920:106) own definition the inferior volsella of *Limnochironomus* could be imperfectly bi- or trilobed; a cordiform apex (as in *D. cordatus*) is imperfectly bilobed. As has been shown in Contreras-Lichtenberg (1986) and Epler (1987a), on the basis of the immature life stages *Limnochironomus* is a junior synonym of *Dicrotendipes.*

Freeman (1957) redefined *Chironomus* in much broader terms and included *Dicrotendipes* as a subgenus. He also synonymized *Carteria* and *Carteronica* with *Chironomus* (*Dicrotendipes*). The gonostylus of *Carteronica* species was very short and wide. Goetghebuer (1936:465) had described a species from Africa with a similar gonostylus, *Chironomus* (*Carteria*) *regalis,* and Freeman (1957) included this species and 2 new species with similar gonostyli, *penicillatus* and *multispinosus,* in his *Chironomus* (*Dicrotendipes*). He did not use structural similarities in the males to synonymize these 2 genera, but relied on similar thoracic color patterns of the females.

Hamilton et al. (1969) used the genus *Chironomus* in a stricter sense. Instead of a large genus with many subgenera, they preferred to use several smaller genera, in accordance with current European workers. *Dicrotendipes* was elevated back to the genus level.

Calochironomus and *Limnochironomus* are definitely junior synonyms of *Dicrotendipes.* However, *Carteronica* is not. This is based on examination of reared material of *Chironomus* (*Carteria*) *regalis* Goetghebuer and *Chironomus longilobus* (Kieffer) (type-species of *Carteronica*) from the Orient and Africa made available to me by Dr. L. Hare. *Carteronica* (replacement name for *Carteria* Kief-

fer, 1921) was removed from synonymy with *Dicrotendipes* (Epler 1987a). It should also be noted that the Afrotropical species which resemble *Carteronica* placed in *Dicrotendipes* by Freeman & Cranston (1980) (*crispi* Freeman, *multispinosus* Freeman, *penicillatus* Freeman and *regalis* Goetghebuer), are not *Carteronica,* but represent another, new, genus (manuscript in preparation).

Kimius, a monotypic genus established by Ree (1981) for the species *hoonsooi,* was included as a synonym of *D. niveicaudus* (Kieffer) (= *D. pelochloris*) by Sasa & Hasegawa (1983). I have seen specimens of this species and agree with the synonymy.

Generic synonyms are listed below. These are followed by an emended diagnosis for the genus incorporating new information discovered during the present study. A list of recognized species names (72) is given in Appendix 1. Appendix 2 is a list of recent specific synonymies in *Dicrotendipes.*

Genus *DICROTENDIPES* Kieffer

Dicrotendipes Kieffer 1913:23. Type-species: *Dicrotendipes pictipennis* Kieffer, 1913 (junior homonym, preoccupied by *pictipennis,* Philippi, 1865; = *Polypedilum quatuordecimpunctatum* Goetghebuer, 1936 = *Dicrotendipes pilosimanus* Kieffer, 1914 = *Chironomus septemmaculatus* Becker, 1908), by monotypy.

Limnochironomus Kieffer 1920:166. Type-species: *Tendipes falciformis* Kieffer, 1912, (= *nervosus* Staeger), by original designation.

nec *Carteria* Kieffer 1921b:590. Type-species: *Chironomus longilobus* (Kieffer, 1916), by original designation (junior homonym preoccupied by *Carteria* Diesing 1866); Freeman & Cranston 1980:190; Ashe 1983:15,21.

Calochironomus Kieffer 1921a:274. Type-species: *Calochironomus fusconotatum* Kieffer, 1922, by designation of Kieffer (1922:66).

nec *Carteronica* Strand 1928:48 (replacement name for *Carteria* Kieffer 1921); Freeman & Cranston 1980:190; Ashe 1983:15,21.

Chironomus (*Limnochironomus*), Goetghebuer 1928:50, Goetghebuer 1936:464, Goetghebuer 1937–1954:19.

Chironomus (*Chironomus*) Group C, Edwards 1929:386.

Sernowia Aristovskaya 1935:114. *Nomen nudum.* (No type-species designated).

nec *Chironomus* (*Carteria*), Goetghebuer 1936:465.

Chironomus (*Dicrotendipes*), Goetghebuer 1936:466; Goetghebuer 1937–1954:31.

Chironomus (*Calochironomus*), Goetghebuer 1936:467.

Chironomus (*sensu stricto*), Goetghebuer 1936:470 (partim).

Limnotendipes Lenz 1937:6. Type-species: *Chironomus* (*Limnochironomus*) *flexus* Johannsen, 1932, by monotypy.

Cladotendipes Lenz 1937:7. Type-species: *Chironomus inferior* Johannsen, 1932. by monotypy.

Tendipes (*Limnochronomus*), Townes 1945:102; Hauber & Morrissey 1945:287; Roback 1957:109.

Dicranotendipes Kruseman 1949:254 (misspelling).

Kimius Ree 1981:217. Type-species: *Kimius hoonsooi* Ree, 1981 (synonym of *D. pelochloris* (Kieffer, 1912)) by original designation; Sasa & Hasegawa 1983:321.

DESCRIPTION: **Adult male.** Medium sized chironomids, light yellow-green to dark green or light brown to dark red-brown. Legs sometimes banded, wings sometimes spotted or banded.

Eyes bare. Temporal setae in 1–3 rows beginning mesad to dorsomesal extension of eye, ending behind eye. Frontal tubercles present, small (2 μm) to medium (28 μm), very rarely absent. Antennal flagellum with 11 flagellomeres. Maxillary palp 5-segmented, basal segment weakly sclerotized and bearing one large lateral seta; segment 3 with specialized sensillae near apex. Clypeus subquadrate, setose. Cibarial setae present.

Antepronotum bare, narrowed and weakly notched dorsomesally. Thoracic scar well developed; humeral pit usually present dorsocaudally to thoracic scar. Scutal tubercle well to poorly developed, or absent. Acrostichal setae when present in double row (absent or reduced in some species), anteriorly beginning close to antepronotum and running posteriorly to anterior base of scutal tubercle (if present) or approximately mid-scutum. Dorsocentral setae in 1–3, usually 2, rows/side. Scutellar setae in 1–3 rows. Supraalar seta 1, rarely 2, /side. Prealar setae 2–7/side. Wing membrane without setae; squama with setal fringe. Brachiolum with 1–5 setae and 2 groups of campaniform sensilla; R, R_1 and R_{4+5} with setae; costa ends at R_{4+5}; FCu proximal, below, or distal to RM.

Metatarsal beard present or absent on foreleg, almost always present on hind leg. Foretibia with inner apical rounded scale which projects slightly beyond similar scale on outer tibial apex. Middle and hind tibiae with 2 combs each, barely separated, each comb bearing one spine which projects beyond others. Sensilla chaetica present on metatarsus of middle leg, usually confined to apical 1/5, occasionally running almost entire length of tarsomere; also sometimes present on hind metatarsus. Pulvilli 2 entire lobes; empodium thin, with sparse ventral fringe.

Abdominal sternite VI (and sometimes V or VII) with or without a medial group of ventral accessory setae, which are easily lost.

Gonostylus usually evenly curved on inner and outer margins, bearing one short, stout seta apically and several to many longer setae on inner preapical margin. Superior volsella well developed; digitiform, deltoid, pediform, elongate-cylindrical or bifid with sclerotized superior portion and membranous-lamelliform inferior portion; usually bare dorsally, bare or with microtrichia ventrally; often membranous apically; bearing several to many large sensilla chaetica on mesal and/or ventral surface. Inferior volsella well developed, usually strongly bowed dorsoventrally, usually with an expanded clubbed or slightly to deeply bifid or trifid apex bearing several to many long, strong sensilla chaetica. Rarely, a membranous median volsella present (2 species). Anal point of hypopygium pyriform to elongate-spatulate, occasionally with shelf-like basal lateral extension, usually slightly deflexed (strongly deflexed in some species).

Female. Generally similar to male; abdomen and wings stouter, and overall generally more setose than male. Genitalia with well developed dorsomesal and ventrolateral lobes; a well developed apodeme lobe present, usually covered with fine microtrichia (reduced in some species, very well developed in some species). Labia without microtrichia. Seminal capsules spherical to ovoid, with weak to moderate neck, spermathecal ducts without loops or bends.

Pupa. Light green to green or brown in life; exuviae almost colorless to dark brown. Cephalic tubercles present (essentially absent in *D. flexus*), poorly to well developed, broadly to narrowly conical, each with a short preapical frontal seta. Dorsum of thorax weakly to strongly granulose or pebbled, usually with a circular humeral callus lateroventral to base of thoracic horn. A scutal tubercle sometimes present. Thoracic horn with more than 50 branches emanating from 2 main trunks. Base of thoracic horn usually somewhat dumbbell-shaped, tracheal bundles usually separate (but joined in several species). Precorneal setae 2–3, dorsocentral setae 4, rarely 5.

Abdominal segment I without lateral setae, segments II–IV with 3 lateral hairlike setae, V–VII with 4 lateral lamellar setae, VIII with 4 or 5 lateral lamellar setae. Anal lobe with an anterior pair of dorsal setae, easily lost; a pair of dorsal caudolateral lamellar setae; and 30+

ventral lateral lamellar setae on each lobe, usually uniserial, at times partially biserial. An uninterrupted row of caudal hooklets on T II. Intersegmental conjunctiva of T III/IV–T V/VI usually with fine spinules. Sternites I–III with or without 1–2 transverse rows of spines. Caudolateral corners of VIII with one to many, weakly to strongly developed, straight to strongly sinuate spurs. Shagreen occasionally present on T I, present as fine longitudinal band(s) or generally spread spinules on S I. Ventral shagreen on S II and III present as 2–4 longitudinal bands connected by a transverse anterior band; weak to absent on S IV–VI (strongly developed in 1 species). Dorsal shagreen on T II–VI subquadrate, hourglass-shaped, or triangular in outline; often with small, separate elliptical to round anterolateral shagreen areas which may merge with median shagreen area. Segment VII often with rounded anterolateral shagreen areas, better developed dorsally. Dorsal shagreen of VIII usually U-shaped, or 2 longitudinal bands, or a pair of anterior and caudal oval to round areas, or almost completely covering dorsal area (*D. flexus*); ventral shagreen of VIII at most a weak copy of dorsal pattern, usually more reduced. Small caudolateral spine groups present on T V–VII. Pedes spurii A well developed on S IV. Pedes spurii B present on II. Segments II–VIII with one dorsal and one ventral pair O-setae. Segment I with 2–3 ventral, 2–4 dorsal pairs of setae; II with 3–4 ventral, 3–5 dorsal pairs; III with 3–4 ventral, 5 dorsal pairs; IV–VII with 4 ventral, 5 dorsal pairs; VIII with 1 ventral and 1 dorsal pair of setae. T VIII usually with small posterolateral dorsal lobes mediad of caudolateral spurs. In species with larvae possessing ventral tubules, weak ventral tubules should be present caudolaterally on S VIII (I have not yet observed such tubules on *Dicrotendipes* pupae).

Larva. Body pale green to green suffused with cream and/or red in life. Head capsule pale yellow to red-brown, often with a dark middorsal stripe over frontal apotome; postmentum often darker than remainder of head capsule. Mentum and mandibular teeth dark red-brown to black. Three pairs of eyespots, the ventral 2 pairs often joined, giving the appearance of only 2 pairs of eyespots. Dorsal eyespot largest, roughly oval to triangular in outline.

Antenna with 5 segments, segment 1 2–4X longer than second, segment 4 greater or approximately equal to 3. Antennal blade arises from apex of segment 1, reaching to 4th or 5th segment. Lauterborn organs and well developed style present at apex of segment 2.

Frontal apotome usually concave and roughly tuberculate along frontal suture, sometimes fused with 1st labral sclerite (forming a frontoclypeal apotome); usually with a small to large ventral anteromedian frontal pit and/or frontal process; or a larger ventral suboval to subquadrate area. Labrum with setae I–IVA + B present; S I moderately plumose; S II large, unfringed; S III hairlike; S IVA small, 2-segmented, S IVB subequal to S IVA, simple. Laterad to S II is a group of 3 fringed labral chaetae, subequal to S II, and 3–4 smaller chaetae. Labral lamella with fringe of 20–75 teeth. Pecten epipharyngis usually with 3–9, rarely 10–13, usually rounded, ventral lobes. 5–8 chaetulae laterales. Premandible distally bifid, the inner blade subequal to 2–3X wider than outer blade; 1–3 inner medial teeth usually present; a medial premandibular brush present.

Mandible with apical tooth, 1–2 dorsal preapical teeth, and 3 inner teeth, the proximal inner tooth sometimes modified. Pecten mandibularis composed of 6–18 strong setae. Seta subdentalis widest at middle, 4–7 times longer than wide; sometimes with accessory tooth. Seta interna with 4 main branches, united basally.

Mentum with 11–13 teeth, the median tooth and 1st laterals usually subequal, median tooth often notched mesolaterally, 2nd lateral tooth often fused or partially fused with 1st lateral; 5th and 6th lateral teeth sometimes rounded and fused. Ventromental plates 1.4X–2.2X wider than long, deeply striate, with smooth or crenulated anterior margin. Setae submenti usually simple, sometimes distally divided in many species.

Triangulum occipitale very narrow, scarcely visible in ventral view.

Ventral tubules usually absent, occasionally 1 pair present on 8th abdominal segment. Procercus wider than long or as wide as long, with 6–8 apical setae; 2 anterolateral preapical setae located on lightly sclerotized preapical plate. A pair of well developed supraanal setae present. Two pairs of anal tubules, usually somewhat conical, sometimes rounded and reduced (in brackish water species); ventral pair usually larger than dorsal pair.

Notes on the Holarctic *Dicrotendipes*

Epler (1987a) revised the Nearctic *Dicrotendipes.* The western Palaearctic species have recently been revised (Contreras-Lichtenberg 1986). A considerable amount of Palaearctic material, mostly of species with western Holarctic distributions, was available and is included in this study. In addition, eastern Palaearctic material of *D. pelochloris* (see Chap. IV) and *D. septemmaculatus* (see Chap. II) was available. Two additional species have recently been described from the eastern Palaearctic: *D. inouei* Hashimoto, 1984 and *D. tamaviridis* Sasa, 1981. Because the descriptions of these species are incomplete and no material was made available to me, *D. inouei* and *D. tamaviridis* are not included in this study.

Epler (1987a:51) noted the similarities between the immature stages of *D. incurvus* (Sublette, 1964) and *D. tritomus* (Kieffer, 1916), but had insufficient comparative material to make a more definite statement. Observing the illustration of *D. tritomus* (as *Limnochironomus*) in Pinder (1978:Fig. 158B), I erroneously stated that the apex of the superior volsella of *D tritomus* was turned out, not in as in *D. incurvus.* Recent examination of additional reared Palaearctic material of *D. tritomus* (through the kindness of Drs. P.H. Langton and F. Reiss) and Contreras-Lichtenberg's (1986:Fig. 14) recent redescription and illustration of this species revealed that the apex of the superior volsella of *D. tritomus* is directed mesad. The adult was originally described (Thienemann & Kieffer 1916) as having a trifid apex on the inferior volsella, or at least 3 apicodorsal rows of sensilla chaetica (Contreras-Lichtenberg 1986). Contreras-Lichtenberg (1986:671) used the number of dorsal rows of sensilla chaetica and the bifid or trifid nature of the apex of the inferior volsella as a secondary character in her key to separate *D. tritomus* from *D. modestus* (Say). However, many specimens, particularly from the Nearctic (*D. incurvus*), possess only a bifid apex, or 2 rows of apicodorsal sensilla chaetica (although I have also seen many Nearctic specimens with 3 dorsal rows), and Goetghebuer (1937–1954:19) stated in his key that the apex could be bifid or trifid. I have examined many specimens of *D. modestus* which have 3 or more rows of apicodorsal sensilla chaetica on the inferior volsella (see Epler 1987a:71; Fig. 92).

The immature stages of *D. incurvus* and *D. tritomus* are also inseparable to me and I conclude that the 2 species are synonymous. The holotype of

D. tritomus, as many of Kieffer's species, is apparently lost; I have not located one and Contreras-Lichtenberg did not examine it. I am using *D. tritomus* here in the sense of Lenz (1954–1962), Langton (1984), Pinder (1978) and Contreras-Lichtenberg (1986). Thus, *D. tritomus* is the fourth species of *Dicrotendipes* with a Holarctic distribution (see Chap. V).

The character, the presence of a second dorsal mandibular tooth, that Contreras-Lichtenberg (1986:670) uses for separating the larvae of *D. modestus* and *D. tritomus* is not reliable. I have seen a specimen of *D. tritomus* from Great Britain without a second tooth, and have seen many specimens of *D. modestus* with a second dorsal tooth or at least a definite large notch in the dorsal tooth. The second dorsal tooth is often difficult to observe unless the mandible is positioned correctly. The larvae of these 2 species are difficult to separate; usually the count of the ventromental plate strial ridges and differences in postmental coloration will separate them (see key below), but specimens must be reared to confirm species identity. Likewise, Contreras-Lichtenberg's (1986) pupal key will fail to separate these 2 species.

The pupa of *D. peringueyanus* as described by Contreras-Lichtenberg (1986) is not separable from *D. fusconotatus* or *D. pallidicornis* (see also Chap. II). In her pupal key, Contreras-Lichtenberg (1986) separates *D. peringueyanus* from *D. pallidicornis* based on the absence of conjunctival spinules on *D. pallidicornis.* However, all specimens of *D. pallidicornis* which I have examined do possess these spinules.

The following keys are offered for the identification of all known life stages (excepting the adult females) of the Holarctic *Dicrotendipes.* The reader is advised to consult the illustrations, descriptions and diagnoses in Contreras-Lichtenberg (1986) and Epler (1987a).

Key to Adult Males of Holarctic *Dicrotendipes*

(*D. inouei, D. tamaviridis* not included)

1. Inferior volsella deeply bifid apically; Palaearctic species 2
   Inferior volsella with simple apex, at most notched, appearing shallowly bifid or trifid; Holarctic species 5
2. Wings with spots or bands, or clouds along veins 3
   Wings immaculate. . . . . *D. pallidicornis* (Goetghebuer)
3. Small, membranous, triangular flap-like appendages present near base of anal point . . . . . *D. fusconotatus* (Kieffer)
   Base of anal point without appendages. 4
4. Wing with 6–7 well-defined spots, with 1 spot usually present in cell m_{3+4} . . . . . *D. septemmaculatus* (Becker)
   Wing with weakly defined spots, none present in cell m_{3+4} . *D. peringueyanus* Kieffer
5. Inferior volsella with membranous dorsal extension; Palaearctic . *D. notatus* (Meigen)
   Inferior volsella without membranous dorsal extension; Holarctic 6

6. Anal point sharply reflexed ventrad, usually not visible in dorsal view (Fig. 36); eastern Palaearctic . . . . . *D. pelochloris* (Kieffer)
   Anal point not sharply reflexed ventrad, visible in dorsal view; Holarctic 7
7. Superior volsella strongly pediform, apex directed outward; or triangular 8
   Superior volsella digitiform, long and slender, or long with weakly expanded membranous apex; if somewhat pediform, then apex directed inward 14
8. Superior volsella triangular, or if weakly pediform, sensilla chaetica restricted to posterior margin of superior volsella; coastal, brackish water species of SE U.S.A. . . . . *D. lobus* (Beck)
   Superior volsella pediform; sensilla chaetica not restricted to posterior margin of volsella 9
9. Legs strongly banded; Nearactic species . . . . . *D. californicus* complex 10
   Legs not banded, at most distal portions of some leg segments darker; Holarctic species 11
10. AR 2.13–2.36, mean 2.29; SV_2 4.15–4.41, mean 4.29; SV_3 2.71–2.89, mean 2.80; known from central and eastern New Mexico and Imperial Dam vicinity, California (possibly Kansas) . . . . . *D. crypticus* Epler
    AR 2.29–2.69, mean 2.47, SV_2 3.81–4.42, mean 4.07; SV_3 2.61–2.84, mean 2.71; widespread in western U.S. and Mexico . . . . . *D. californicus* (Johannsen)
11. Anal point with raised truncate base; known only from Chiricahua Mountains of SE Arizona . . . . . *D. adnilus* Epler
    Anal point not as above; widespread 12
12. Dorsum of tergite IX with many long setae laterad of anal point; SE U.S.A. . . . . *D. thanatogratus* Epler
    Dorsum of tergite IX not as above 13
13. Gonostylus inflated medially, narrowed proximally and preapically; general coloration brown; Nearctic . . . . . *D. neomodestus* (Malloch)
    Gonostylus not as above; general coloration green to red-brown; Holarctic . . . . . *D. modestus* (Say)
14. Superior volsella short, digitiform 15
    Superior volsella long and slender or long with weakly expanded membranous apex 18
15. Anal point with wide shelf-like base, tapering gradually to apex; superior volsella cylindrical, with slightly out-turned apex; Nearctic . . . . . *D. fumidus* (Johannsen)
    Anal point spatulate or narrowed at base 16
16. Superior volsella with thin membranous preapical extension; metatarsi usually with wide basal white band (lacking in most Florida specimens); Nearctic . . . . . *D. leucoscelis* (Townes)
    Superior volsella not as above; metatarsi without wide basal white band 17
17. Anal point long, narrowly spatulate; superior volsella with sclerotized area at apex; Holarctic . . . . . *D. lobiger* (Kieffer)
    Anal point and superior volsella not as above 18
18. Superior volsella long, slender, recurved, with an acute apex . . *D. botaurus* (Townes)
    Superior volsella not as above 19
19. Apex of superior volsella turned in 20
    Apex of superior volsella turned out; or straight, semiglobose 21
20. Gonostylus long, thin, and strongly curved; superior volsella usually without microtrichia; apex at most semimembranous; Nearctic . . . . . *D. milleri* (Townes)
    Gonostylus not as above; at least basal half of superior volsella with microtrichia, apex membranous; Holarctic . . . . . *D. tritomus* (Kieffer)

21. Superior volsella cylindrical, curving outward; apex bare, not expanded (Fig. 13); thorax with well developed scutal tubercle; SW U.S.A., Mexico . . *D. aethiops* (Townes)
Superior volsella not as above, apex expanded or inflated; thorax with or without scutal tubercle, widespread 22
22. Sensilla chaetica of superior volsella in a line often reaching middle of appendage tip, not directed exclusively inward; length of superior volsella 2–3.25X maximum width; wing with more than 35 setae on R & R_1; Holarctic . . . . . *D. nervosus* (Staeger)
Sensilla chaetica of superior volsella distributed on inner surface of appendage, the majority directed inward; length of superior volsella 4.25–5.25X maximum width; wing with 35 or fewer setae on R & R_1; Nearctic . . . . . *D. lucifer* complex (*D. lucifer* (Johannsen), *D. simpsoni* Epler). (*D. inouei* Hashimoto & *D. tamaviridis* Sasa, both eastern Palaearctic species, may key out here.)

Key to Known Pupae of Holarctic *Dicrotendipes*

1. Ventral spine row(s) present on S II 8
Ventral spine row(s) absent 2
2. 4 lateral lamellar setae on T VIII 3
5 lateral lamellar setae on T VIII 5
3. Shagreen spinules on T II–V largest posteriorly, tips often rounded; exuviae light yellow-brown to dark yellow-brown; Nearctic . . . . . *D. fumidus*
Shagreen spinules on T II–V more or less equal; exuviae clear or light to dark brown; Holarctic 4
4. Median shagreen spinules more or less equal on T VI; exuviae light to dark brown; strongly reticulate cuticular pattern on T VI–VIII, especially on T VI; coastal, brackish water species of SE U.S.A. . . . . *D. lobus*
Median shagreen area on T VI with longest spinules in middle of area; exuviae clear with yellowish borders; reticulate cuticular pattern on T VI–VIII at most moderately developed; Holarctic . . . . . *D. nervosus* group (*D. lucifer, D. nervosus, D. simpsoni*). (*D. tamaviridis* may key here.)
5. Anal lobe with dorsal shagreen; Palaearctic . . . . . *D. septemmaculatus* group (*D. fusconotatus, D. pallidicornis, D. peringueyanus, D. septemmaculatus*)
Anal lobe without dorsal shagreen 6
6. Intersegmental spines present between T V and T VI; Nearctic and western Palaearctic species 7
T V and T VI without intersegmental spines (Fig. 41J); eastern Palaearctic . . . . . *D. pelochloris*
7. Nearctic species . . . . . *D. leucoscelis*
Palaearctic species . . . . . *D. notatus*
8. 5 lateral setae on T VIII . . . . . *D. lobiger*
4 lateral setae on T VIII 9
9. Caudolateral spur on T VIII double or triple, spurs well separated 10
Caudolateral spur on T VIII single or closely appressed double 11
10. Cephalic tubercles long, thin, sharply acute, 33–40, mean 37, anal fin setae; New York, Indiana, Michigan, Minnesota, Oregon, Ontario and Manitoba . . . . . *D. milleri*
Cephalic tubercles shorter, wider; 33–55, mean 45, anal fin setae; Holarctic . . . . . *D. tritomus*

11. Median shagreen area on T VI with larger anterior and/or posterior spinules; widespread 12
Median shagreen spinules on T VI largest anteriorly only or those of posterior portion only slightly larger than middle; west and southwest U.S.A. . . . . .*D. californicus* complex (*D. californicus, D. crypticus*)
12. Dorsum of anal disc with thinly spined anteromesal shagreen areas; known only from Florida . . . . . .*D. thanatogratus*
Dorsum of anal disc without shagreen 13
13. Anterior and posterior spinules of median shagreen area on T VI more strongly developed than those of center; caudolateral spur on T VIII usually strongly recurved or sinuate 14
Posterior spinules of median shagreen area on T VI larger, more rounded or longer than those of anterior portion of shagreen area; caudolateral spur on T VIII not strongly sinuate or recurved, almost straight . . . . . .*D. tritomus*
14. Anal lobe with 31–50, mean 38, lateral setae; Nearctic. . . . . *D. neomodestus*
Anal lobe with 30–64, mean 50, lateral setae (1 specimen seen from Florida with only 30–33 anal lobe setae); Holarctic . . . . . *D. modestus*

Key to Known 4th Instar Larvae of Holarctic *Dicrotendipes*

1. Frontal apotome with a large anteromesal oval or subquadrate area; frontal pit or process absent 2
Frontal apotome without such an area; a small anteromedian frontal pit or frontal process usually present 5
2. A frontoclypeal apotome present; sixth lateral tooth of mentum well developed; 30–41, mean 35, ventromental strial ridges . . . . . .*D. lobiger*
A frontal apotome present; sixth lateral tooth of mentum reduced or closely appressed to 5th. 3
3. Palaearctic species. 4
Nearctic species; 37–60, mean 52 ventromental strial ridges . . . . . .*D. leucoscelis*
4. Eastern Palaearctic species; 30–34, mean 32 ventromental strial ridges (Fig. 41N) . . . . . *D. pelochloris*
Western Palaearctic species; about 40 ventromental strial ridges . . . . . *D. notatus*
5. Second lateral tooth of mentum almost completely fused with or closely appressed to 1st so that 1st lateral tooth appears notched (Fig. 13) 6
Second lateral tooth at most only partially fused to 1st lateral at base, 1st lateral tooth not appearing notched 9
6. Head capsule integument appears coarsely granular at 400X; Nearctic species . . . 16
Head capsule integument at most appears slightly granular at 400X; Nearctic or Palaearctic species 7
7. A long, ventral frontal process present on anteromedian margin of frontal apotome; Palaearctic only . . . . . .*D. septemmaculatus*
Long frontal process absent, but a frontal pit usually present; Nearctic only 8
8. Anal tubules reduced; anterior margin of ventromental plate mostly smooth; coastal, brackish water species of SE U.S.A. . . . . *D. lobus*
Anal tubules normal; at least anterior outer margin of ventromental plate usually crenulated; widespread in Nearctic . . . . . *D. neomodestus*
9. 60–70 ventromental strial ridges; Palaearctic only. . . . . *D. pallidicornis*
Less than 50 ventromental strial ridges; Nearctic or Palaearctic. 10

10. Ventromental plate with 22 or fewer strial ridges; anterior margin deeply scalloped 11
Ventromental plate with more than 22 strial ridges; anterior margin smooth or with shallow to moderate crenulations 12
11. Nearctic species (known only from Florida) . . . . . *D. thanatogratus*
Palaearctic species . . . . . *D. fusconotatus*
12. Proximal tooth of mandible saddle-shaped or with 2 points; or with inner surface of mandible adjacent to proximal tooth with deep semicircular incision; Nearctic. 13
Proximal tooth of mandible mostly triangular in outline, not as above; Holarctic . 14
13. Sixth lateral tooth of mentum rounded and closely appressed or fused to 5th lateral tooth; inner surface of mandible adjacent to proximal tooth with deep semicircular incision . . . . . *D. simpsoni*
Sixth lateral tooth of mentum pointed; inner surface of mandible adjacent to proximal tooth without deep semicircular incision . . . . . *D. lucifer*
14. Sixth lateral tooth of mentum rounded and closely appressed or fused to 5th lateral tooth . . . . . *D. nervosus*
Sixth lateral tooth pointed, separate 15
15. Head capsule integument appears coarsely granular at 400X; head capsule color yellow-brown to yellow-red-brown; Nearctic species 16
Head capsule integument at most appears slightly granular at 400X; head capsule color light brown to brown or pale yellow; Holarctic species 18
16. Postmentum or posterior portion of head capsule usually not darkened; 1st lateral teeth of mentum often turned outward; occurs throughout the Nearctic. . . *D. fumidus*
Postmentum or posterior portion of head capsule much darker than rest of head capsule; 1st lateral teeth of mentum rarely turned outward; western U.S.A. 17
17. Ventromental plate with crenulated anterior margin; 23–28, mean 25, ventromental strial ridges; known from central and eastern New Mexico and Imperial Dam vicinity, California (possibly Kansas) . . . . . *D. crypticus*
Ventromental plate with smooth anterior margin; 34–42, mean 37, ventromental strial ridges; widespread in western U.S.A. . . . . *D. californicus*
18. Head capsule pale yellow 19
Head capsule light brown to brown 20
19. Ventromental strial ridges 28–36, mean 32; postmentum usually darkened . . . . . *D. modestus*
Ventromental strial ridges 23–29, mean 25; postmentum rarely darkened . *D. tritomus*
20. Anterior margin of ventromental plates mostly smooth; known only from Chiricahua Mountains of SE Arizona . . . . . *D. adnilus*
Anterior margin of ventromental plates with shallow to moderate crenulations; widespread in Holarctic . . . . . *D. modestus*

FIG. 1. Adult morphology. A) Structures of head, frontal view. B) Antennal flagellum and pedicel; AR measurement method. C) Cibarial pump and associated structures. D) Method of abdominal length measurement. E) Thoracic structures. F) Ventral accessory setae of (left to right): *D. neomodestus, D. leucoscelis, D. cordatus.* (A, abdominal length; Ac, acrostichal setae; Cls, clypeal setae; CP, cibarial pump; CS, cibarial setae; Dc, dorsocentral setae; HP, humeral pit; LL, labial lonchus; Pa, prealar setae; Ped, pedicel; Pm_{1-5}, maxillary palpomeres 1-5; PPS, postpronotal suture; PS, parapsidal suture; PSS, prescutoscutal suture; Scp, scape; Sct, scutellar setae; Scut, scutellar tubercle; Sp, spiracle; Su, supraalar seta; T, thorax length; Te, tentorium; Tem, temporal setae; THS, thoracic scar; To, torma.)

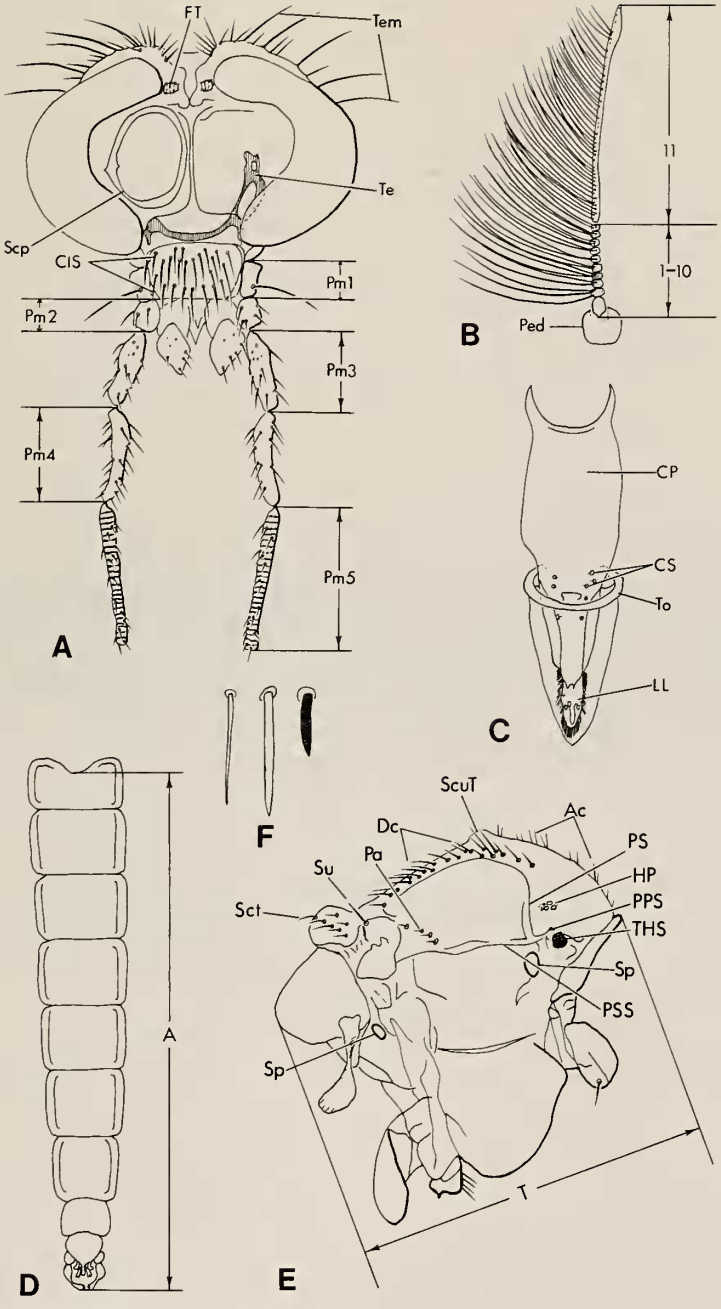
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FIG. 2. Adult morphology. A) Method of measuring all femora & the fore tibia. B) Method of measuring fore metatarsus. C) Method of measuring tibiae & tarsomeres of mid & hind legs. D) Wing (see Saether 1980 for abbreviations). E) Methods of wing measurement. (WL, wing length; WW, wing width.)

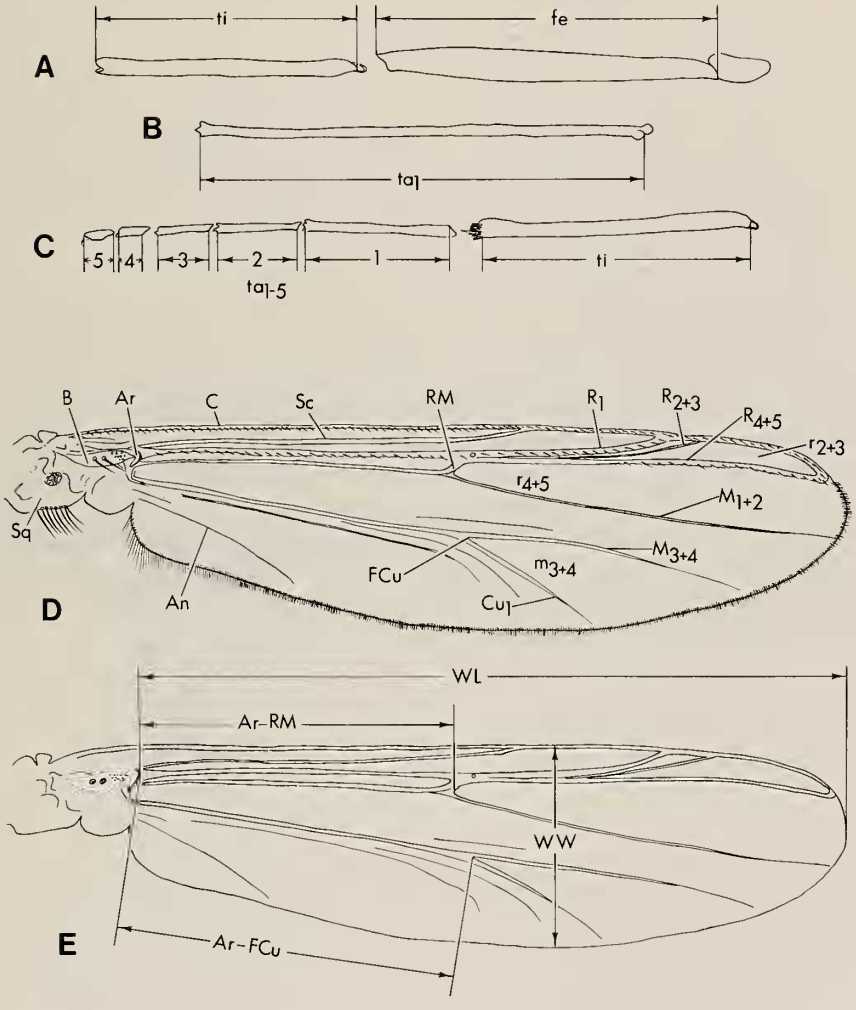
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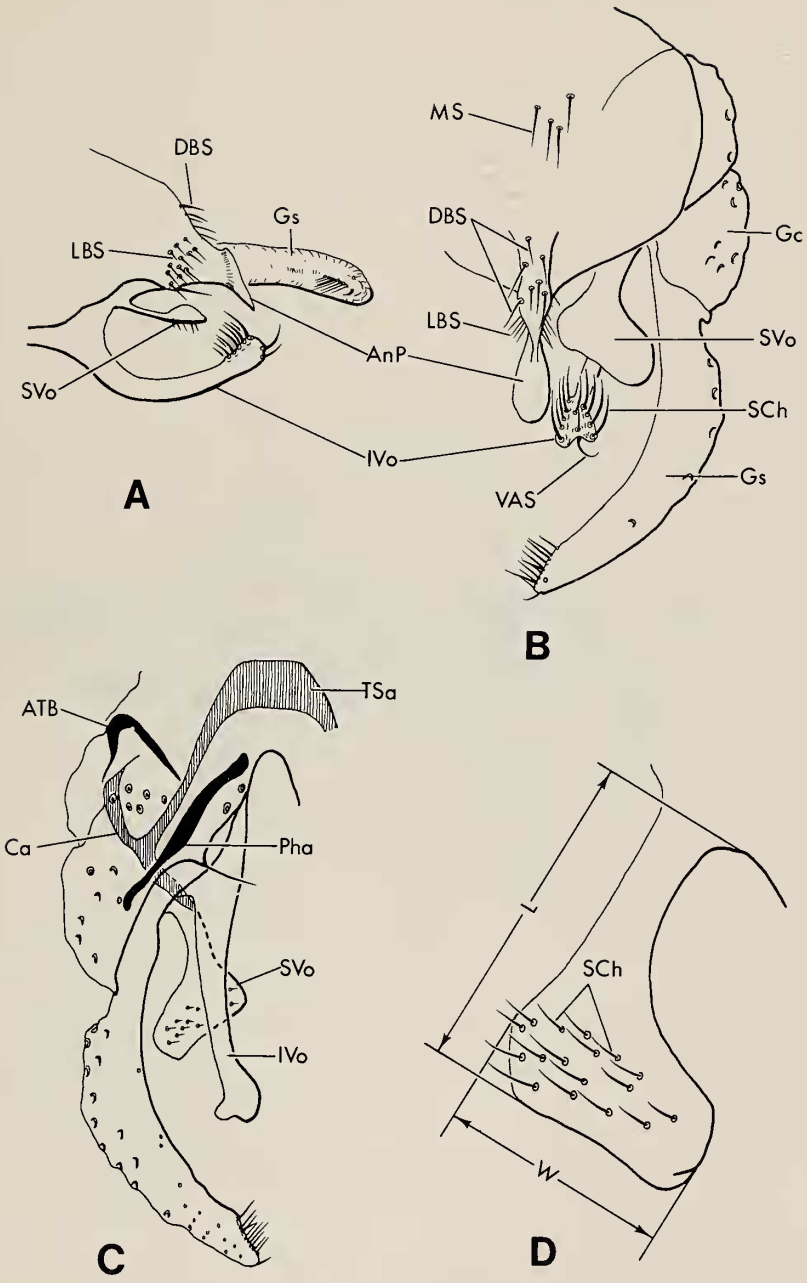
FIG. 3. Adult male morphology. A) Lateral view of hypopygium (nearest gonostylus, inferior & superior volsellae removed). B) Dorsal view of right side of hypopygium. C) Ventral view of right side of hypopygium, showing internal apodemes. D) Ventral view, superior volsella. (AnP, anal point; ATB, anal tergal band; Ca, coxapodeme; DBS, dorsal basal setae; Gc, gonocoxite; Gs, gonostylus; IVo, inferior volsella; L, length of superior volsella; LBS, lateral basal setae; MS, median setae; Pha, phallapodeme; SCh, sensilla chaetica; SVo, superior volsella; TSa, transverse sternapodeme; VAS, ventral apical seta; W, width of superior volsella.)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Pha
SVo
IVo
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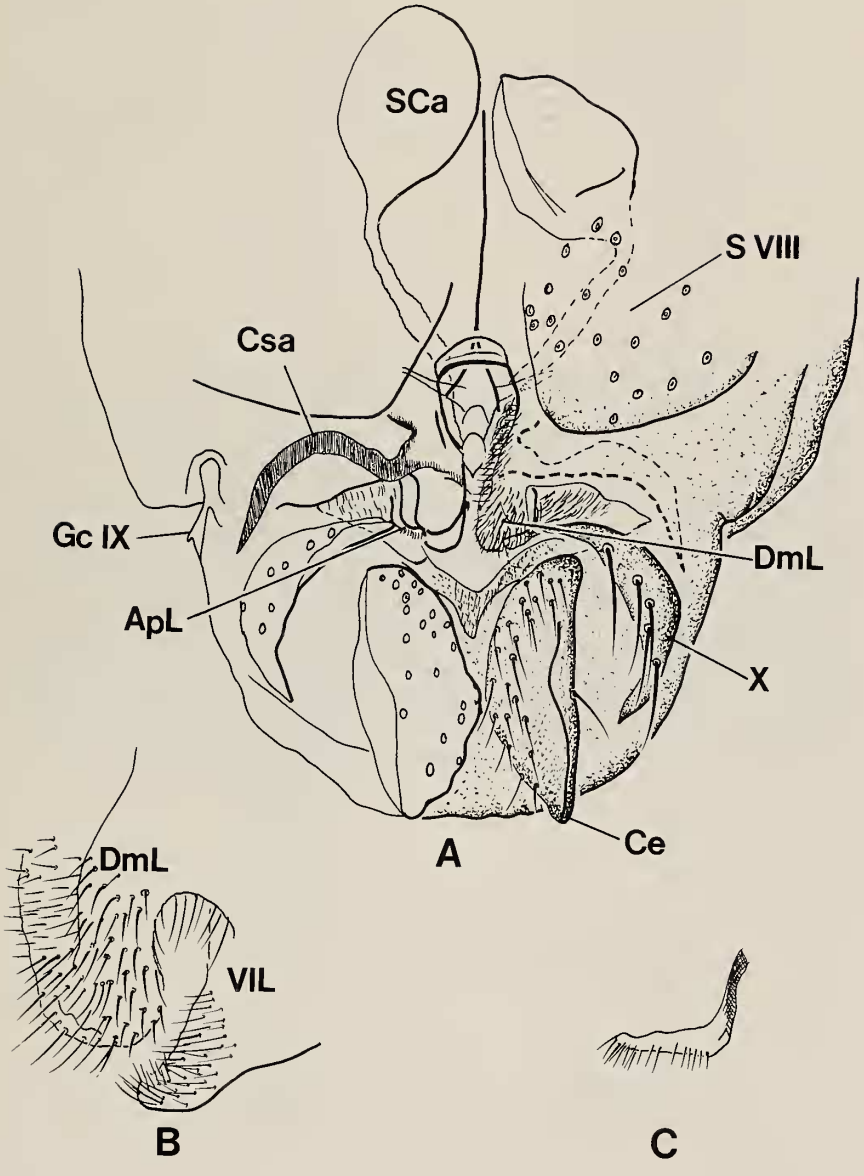
L
SCh
W
D

FIG. 4. Adult female morphology: A) Ventral view of terminalia. B) DmL and VlL. C) ApL. (ApL, apodeme lobe; Ce, cercus; Csa, coxosternapodeme; DmL, dorsomesal lobe; Gc IX, gonocoxite IX; SCa, seminal capsule; S VIII, sternite VIII; VlL, ventrolateral lobe; X, segment X.)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S VIII
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Gc IX
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A
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VIL
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FIG. 5. Pupal morphology. A) Ventral view of spread cephalothorax. B) Lateral view of cephalothorax. C) Dorsal view of anal lobe, depicting method of calculating disc ratio, DR. DR is the total number of ventral anal lobe setae (V) divided by the number of ventral setae anterior to and including dorsal seta position (D); DR = V/D. D) Dorsal view abdomen. E) Ventral view of abdomen. (A, abdomen length; ADS, anterodorsal seta; AS, anterolateral shagreen area; C, cephalothoracic length; CS, caudolateral spur; CT, cephalic tubercle; D, number of ventral setae from dorsal seta position to anterior margin of anal lobe; Dc, dorsocentral setae; DS, dorsal seta; H, hooklets; HC, humeral callus; LLS, lateral lamellar setae; MS, median shagreen area; Pc, precorneal setae; PSA, pedes spurii A; PSB, pedes spurii B; ScuT, scutal tubercle; THB, thoracic horn base; V, total number of ventral anal lobe setae; VS, ventral setae of anal lobe; VSR, ventral spine rows.)

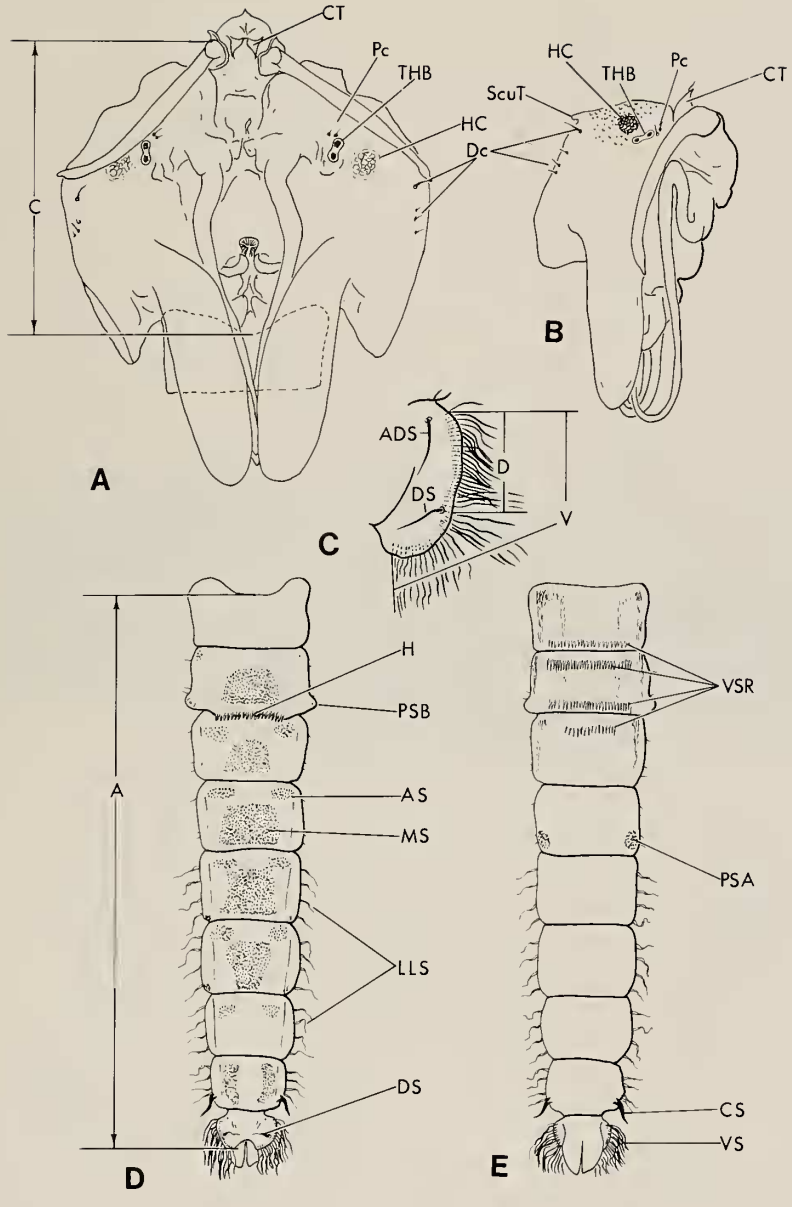
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FIG. 6. Larval morphology: A) Ventral view of head capsule. B) Dorsal view of head capsule. C) Mentum. D) Ventromental plate. E) Premandible. F) Mandible. G) Antenna.(ABl, accessory blade; Bl, antennal blade; FA, frontal apotome; L, length; LO, lauterborn organ; M, mentum width; Man, mandible; Max, maxilla; MT, width of median teeth; PM, postmentum length; PMa, pecten mandibularis; Pm, premandible; PmB, premandibular brush; Po, postocciput; RO, ring organ; S, style; Si, seta interna; Sl 1,2, labral sclerites 1,2; SR, strial ridges; SSd, seta subdentalis; TO, triangulum occipitale; Vm, ventromental plate; W, width.)

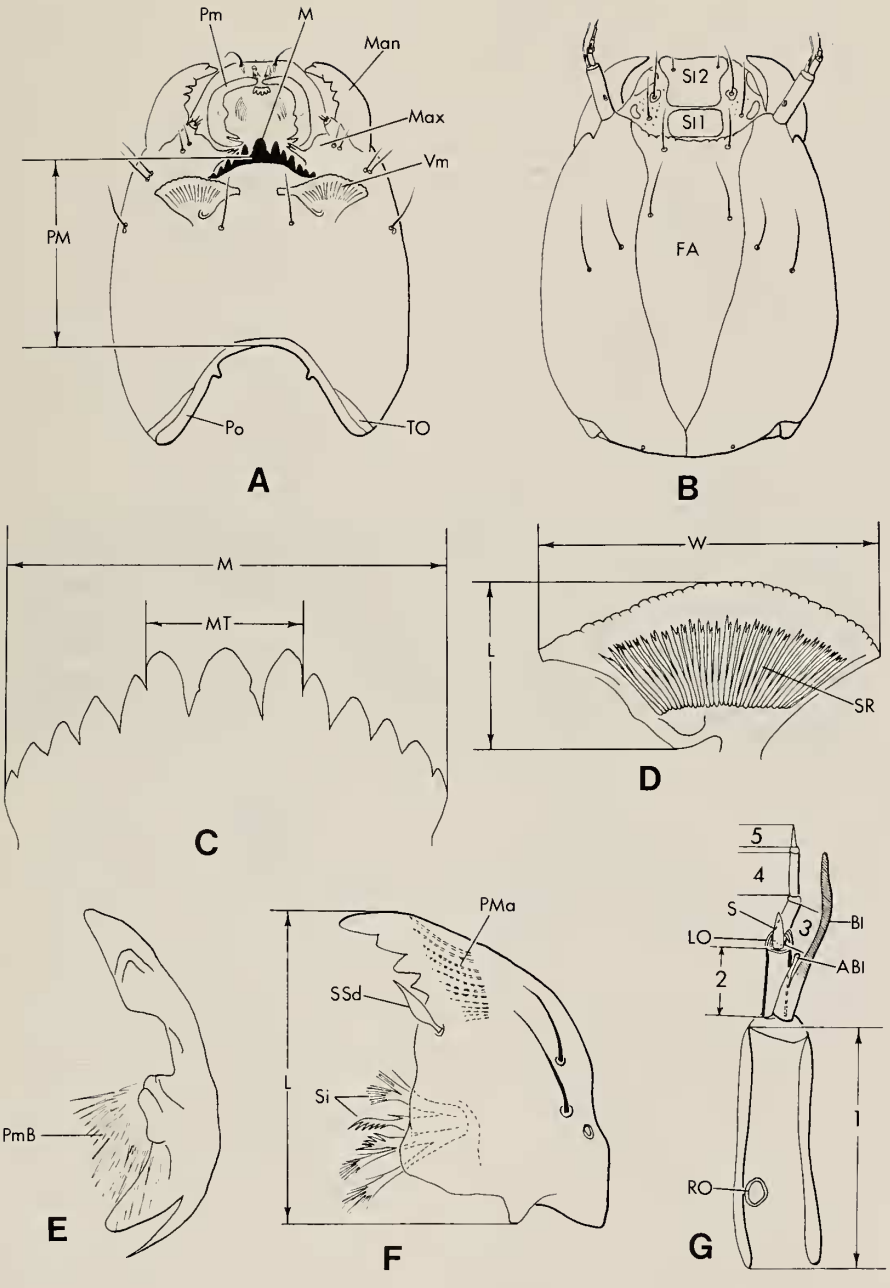
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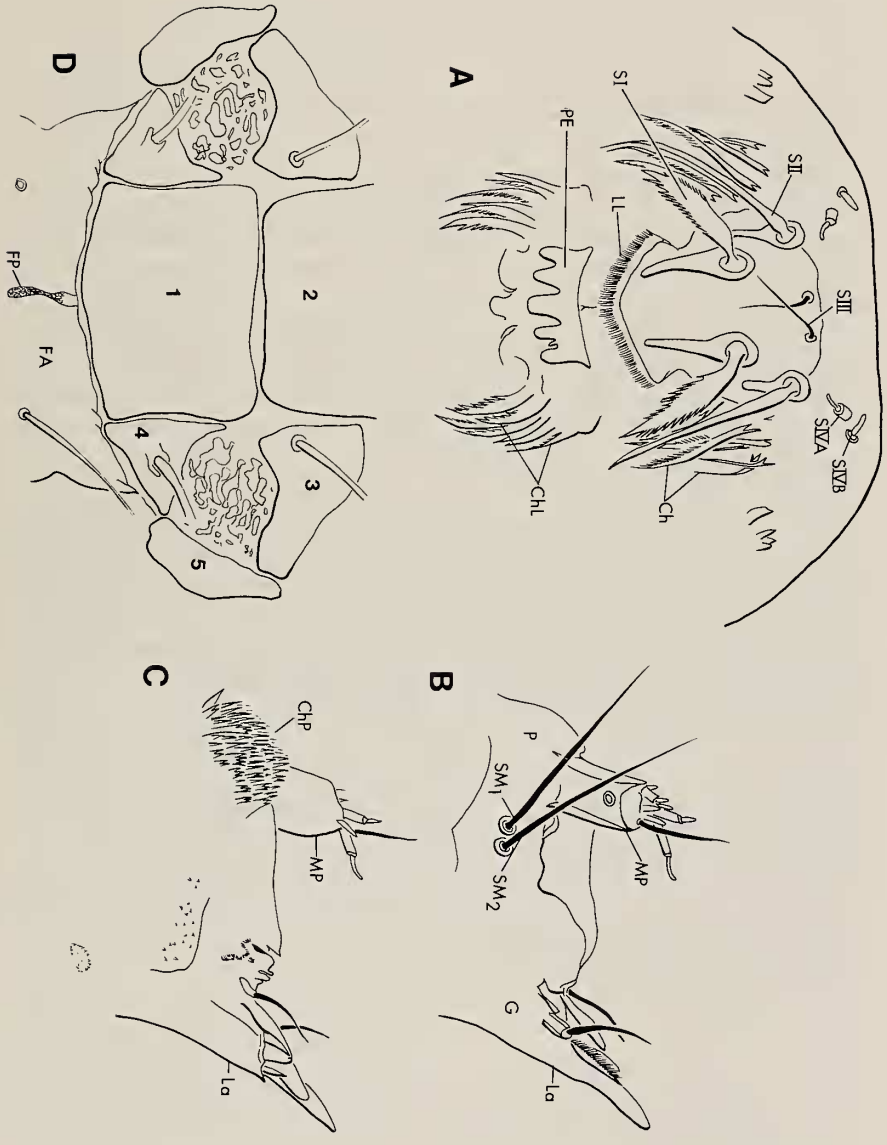
FIG. 7. Larval morphology: A) Palatal surface of labrum. B) Ventral view of maxilla. C) Dorsal view of maxilla. D) Anterior portion of frontal apotome and related labral sclerites 1–5 of *D. fusconotatus.* (Ch, chaetae; ChL, chaetulae laterales; ChP, chaetulae of palpiger; FA, frontal apotome; FP, frontal process; G, galea; La, lacinia; LL, labral lamella; MP, maxillary palp; P, palpiger; PE, pecten epipharyngis; $SM_{1,2}$, setae maxillaris; SI-SIVA, SIVB, labral setae; 1-5, labral sclerites 1-5.)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Chapter II.
A Review of the Afrotropical *Dicrotendipes* With Descriptions of the Immature Stages

This chapter presents a review of the 14 species of Afrotropical *Dicrotendipes* and describes or redescribes the immature stages of 5 species (only the pupal stage is described for *D. cordatus*).

The genus *Dicrotendipes* was originally described from the Afrotropical region (Kieffer 1913b). Freeman (1957) provided a first revision of the Afrotropical species; he included 19 species in *Chironomus* (*Dicrotendipes*), 6 of which he described as new. Freeman & Cranston (1980) provided an updated checklist. These works concentrated only on the adult stages. The immature stages had never been fully described until, in a recent revision of the western Palaearctic *Dicrotendipes,* Contreras-Lichtenberg (1986) described the immature stages of some species which are also found in the Afrotropical region; *D. fusconotatus* (larva and pupa), *D. peringueyanus* (pupa) and *D. septemmaculatus* (larva and pupa, as *D. quatuordecimpunctatus*).

A key to identify adults was provided by Freeman (1957), but one should be aware that Freeman's key included several species no longer considered to be members of *Dicrotendipes*. A new key to the adult males of Afrotropical *Dicrotendipes* is provided below. The species *chloronotus* Kieffer is now considered a *Kiefferulus* (Freeman and Cranston 1980). Freeman (1957) and Freeman and Cranston (1980) erroneously synonymized *Carteronica* Strand (= *Carteria* Kieffer) with *Dicrotendipes* (cf. also Ashe 1983). As noted by Epler (1987a), these genera are not synonymous. The Afrotropical species *crispi* Freeman, *regalis* Goetghebuer, *multispinosus* Freeman and *penicillatus* Freeman, formerly included in *Dicrotendipes,* somewhat resemble *Carteronica* in the adult stage (the species *regalis* was originally described as a *Carteria*). Although these species resemble *Carteronica,* based upon examination of the immature stages of reared *multispinosus* and immature *Chironomus longilobus* (Kieffer) (type-species for *Carteronica*), these Afrotropical species must be placed in a new genus.

At least one other described Afrotropical species, *Xenochironomus trisetosus* (Kieffer, 1922) may be a *Dicrotendipes* (see description in Freeman 1957:381). It possesses an inferior volsella similar to that of *D. bredoi*. Until reared immature stages are available, I believe it best to retain *trisetosus* in *Xenochironomus*.

The following key will replace that found in Freeman (1957:359–360). Descriptions of adults and illustrations of wings and male terminalia can be found in Freeman (1957).

Key to Adult Males of Afrotropical *Dicrotendipes*

1. Wings with spots or bands, or clouds along veins 2
   Wings immaculate. 8
2. Inferior volsella simple, at most apex deeply notched 3
   Inferior volsella with apex deeply bifid. 5
3. Wing with dark distal band covering or touching RM 4
   Wing with dark distal band not touching RM. . . . . *D. leucolabis* Kieffer
4. Superior volsella preapically expanded, appearing somewhat globose . . . . . *D. cordatus* Kieffer
   Superior volsella not preapically expanded. . . . . *D. collarti* (Goetghebuer)
5. Wing pattern weak, consisting of clouds along major veins . . *D. sudanicus* (Freeman)
   Wing pattern consisting of spots (which may be weak in 1 species) 6
6. Small, membranous, triangular flap-like appendages present laterad of anal point. . . . . *D. fusconotatus* (Kieffer)
   Membranous appendages near anal point absent 7
7. Wing with 6–7 well defined spots, with 1 spot usually present in cell m_{3+4} . . . . . *D. septemmaculatus* (Becker)
   Wing with weakly defined spots, none present in m_{3+4} . . . *D. peringueyanus* Kieffer
8. Base of anal point with lateral projections; apex of inferior volsella narrow, not expanded . . . . . *D. bredoi* (Goetghebuer)
   Base of anal point without lateral projections; apex of inferior volsella expanded . . 9
9. Anal point broad and strongly reflexed ventrad. 10
   Anal point not as above 11
10. Superior volsella somewhat cylindrical with globose to pediform apex; apex of superior volsella with mediad membranous area bearing sensilla chaetica; foretarsi without beard . . . . . *D. kribiicola* (Kieffer)
    Superior volsella not cylindrical with globose apex, but rather leaf shaped with attenuate apex; apex of superior volsella without membranous area bearing sensilla chaetica; foretarsi bearded . . . . . *D. ealae* (Freeman)
11. Superior volsella short, globose, with medially directed apical point . . . . . *D. nigrolineatus* (Freeman)
    Superior volsella somewhat cylindrical or with elongate pedicel. 12
12. Inferior volsella with large swollen apex; superior volsella with small mesally directed apical point . . . . . *D. schoutedeni* (Goetghebuer)
    Inferior volsella with normal, moderately expanded apex; superior volsella without small mesally directed apical point. 13
13. Anal point long and thin, with 2–4 dorsal basal setae . *D. freemani* Epler, nom. nov.
    Anal point shorter, wider, with more than 6 dorsal basal setae . . . . . *D. chambiensis* (Goetghebuer)

Dicrotendipes bredoi (Goetghebuer)

Chironomus Bredoi Goetghebuer, 1936:473.
Chironomus (*Dicrotendipes*) *bredoi* Goetghebuer: Freeman 1957:369.
Dicrotendipes bredoi (Goetghebuer): Freeman and Cranston 1980:190; Hare & Carter 1987:70.

See adult description in Goetghebuer (1936:473) and Freeman (1957:369); the immature stages are unknown.

This is quite an unusual species for a *Dicrotendipes,* and may not belong here but in another, possibly new, genus. The superior and inferior volsellae are not typical for *Dicrotendipes.* Examination of the immature stages is needed before this species can be placed with certainty. There are no ventral accessory setae apparent on S VI. The specimen from Nigeria represents the first record for this species from that country.

MATERIAL EXAMINED: NIGERIA: Lake Opi nr Nsukka, light trap, 29-30-XII-1979, leg. L. Hare, 1 male (LH). [ZAIRE]: "Belgian Congo," Eala, X-1929, H.J. Bredo, 1 male (holotype) (KM).

Dicrotendipes chambiensis (Goetghebuer) (Fig. 8)

Chironomus (*Limnochironomus*) *chambiensis* Goetghebuer, 1936:464.
Chihronomus (*Dicrotendipes*) *chambiensis* Goetghebuer: Freeman 1957:368.
Dicrotendipes chambiensis (Goetghebuer): Freeman and Cranston 1980:190.

See adult description in Goetghebuer (1936:464) and Freeman (1957:368); the immature stages are unknown.

The superior volsella of the holotype of *D. chambiensis* (Fig. 8C) is somewhat stouter than that of *D. freemani* (Fig. 8A), and is apparently distorted from preparation procedures. Specimens from Zaire and South Africa in the BM determined as *chambiensis* have superior volsellae (Fig. 8D) which are more similar to the Nearctic *D. lucifer* complex (Epler 1987a: Figs. 111, 112), and possess numerous dorsal basal or dorsomesal setae on T IX. *D. freemani* specimens have 2–4 T IX dorsal basal setae and superior volsellae more similar to those of *D. nervosus* (Epler 1987a: Figs. 105–109). I could not discern any dorsal setae on T IX of the *D. chambiensis* holotype specimen. The Zaire and South Africa specimens might represent a new species, but without reared associations I cannot justify "splitting" the species. The differences between the anal points and inferior volsellae of *D. freemani* (as *binotatus*) and *D. chambiensis* cited by Freeman (1957:368) and utilized in the key above could be attributed to individual variation, as can the differences in the superior volsellae. It should also be noted that superior volsellae with menbranous apices, such as those possessed by *D. freemani* and *D. chambiensis,* are very sensitive to pressure induced variations caused by mounting procedures.

The hypopygium of the *D. chambiensis* holotype was mounted between 2 pieces of celluloid on the pin with the rest of the specimen and was in very poor condition. The mount had split open, the mounting medium had dried and broken the hypopygium. I remounted the hypopygium in balsam on a microscope slide and was able to salvage the gonocoxae, one superior

volsella and T IX with the anal point; the inferior volsellae and the gonostyli are lost.

MATERIAL EXAMINED: [SOUTH AFRICA]: Transvaal: Blaaubank River, IV-1957, A.D. Harrison & B.R. Allanson, 1 male (BM); Blaaubank River nr Sterkfontein, IV-1957, A.D. Harrison & B.R. Allanson, 1 male (BM). [ZAIRE]: Elizabethville, 17, 24-XII-1938, H.J. Bredo, 2 males (BM); Escpm. Kabasha: Chambi, X-1933, Dr. De Wulf, 1 male (holotype) (KM).

Dicrotendipes collarti (Goetghebuer)

Chironomus (*Dicrotendipes*) *collarti* Goetghebuer, 1936:466; Freeman 1957:366.
Dicrotendipes collarti (Goetghebuer): Freeman and Cranston 1980: 190.

See Goetghebuer (1936:466) and Freeman (1957:366) for the adult description; the immature stages are unknown. I have seen one male with 9 heavy spine-like setae on S VI.

MATERIAL EXAMINED: KENYA: Aberdare Range, Chania Falls, 4,000 feet, B.M.E. Afr. Exp., X-1934, F.W. Edwards, 1 male (BM). [ZAIRE]: "Belgian Congo": Ituri, Alokoko, 11-II-1930, A. Collart, 1 male (holotype) (KM); Katanga, Kafubu Mission, IX-1931, Miss A. Mackie, 1 male (BM).

Dicrotendipes cordatus Kieffer (Figs. 1, 9)

Dicrotendipes cordatus Kieffer, 1922:64; Freeman 1955a:22; Freeman and Cranston 1980:190; Hare & Carter 1987:70.
Paratendipes pictus Goetghebuer, 1934:199.
Chironomus (*Paratendipes*) *pictus* (Goetghebuer): Freeman 1954a: 443.
Chironomus (*Dicrotendipes*) *cordatus* (Kieffer): Freeman 1957:365; Dejoux 1968:56.

See adult description in Kieffer (1922:64) and Freeman (1957:365). There are 4–6 heavy spine-like ventral accessory setae on S VI (Fig. 1F). The holotype of *D. cordatus* is apparently lost (Freeman 1957:366).

This species is probably closely related to the Afrotropical *D. kribiicola,* the Nearctic *D. leucoscelis* and the Palaearctic *D. notatus.*

PUPA: (n = 3)

COLOR. Light brown, with darker areas along lateral margins of tergites.

LENGTH. Total 4.38–5.03, 4.64 mm. Cephalothorax 1.11–1.16, 1.13 mm. Abdomen 3.27–3.92, 3.52 mm.

CEPHALOTHORAX. Cephalic tubercles well developed (Fig. 9A). Dorsum moderately to well pebbled. Dc_2 closer to Dc_3. Thoracic horn base (Fig. 9B) with tracheal bundles narrowly joined or fused medially.

ABDOMEN (Fig. 9C). Sternites I-III with fine lateral shagreen bands; S I with posterior band; S II occasionally with anterior band. Tergite I without shagreen; T II with median quad-

rilateral shagreen area; T III-V with larger median quadrilateral shagreen area, areas extended laterally on anterior portion; T VI with Y or T shaped shagreen area; T VII with anterior band of fine shagreen and a pair of posterolateral ovoid shagreen areas; T VIII with an anterior pair of ovoid fine shagreen areas and a smaller posterior pair of ovoid shagreen areas; shagreen areas on T II-VI with spines larger in middle of area. Tergites III-V with posterior conjunctival band of fine spinules; T V posteriorly with 2 groups of intersegmental spines, 2-6 spines in each group; T VI-VIII with weak to moderate reticulate cuticular pattern posterolaterally. Posterior margin of T II with transverse row of 64-101, 84 hooklets. T VIII with 5 lateral setae. Caudolateral spurs on T VIII (Figs. 2D, E) single or multiple, small. Anal lobes with 45-54, 49 setae. DR 2.76–3.16, 2.92.

MATERIAL EXAMINED: NIGERIA: Lake Opi nr Nsukka, 14-27-I-1979, leg. Landis Hare, 1 male, 1 female/Pex, 2 Pex (LH). Kafanchan, 6-V-1979, J.C. Deeming, 1 male (BM). SUDAN: Khartoum, at light, XI-1951, D.J. Lewis, 3 males (BM). Liednum nr Wau, 13-IV-1955, E.T.M. Reid, 1 male (BM). UGANDA: Lake Nabugabo, 13-XI-1934, F.W. Edwards, 1 male (BM).

Dicrotendipes ealae (Freeman)

Chironomus (*Dicrotendipes*) *ealae* Freeman, 1957:369; Dejoux 1968:57.
Dicrotendipes ealae (Freeman): Freeman and Cranston 1980:190.

See adult description in Freeman (1957:369); the immature stages are unknown. There are no ventral accessory setae apparent on S VI.

MATERIAL EXAMINED: S[OUTH] A[FRICA].: Natal: Howick Falls, 6-IV-1953, G.H. Satchell, 2 males (holotype, paratype) (BM).

Dicrotendipes freemani nom. nov. (Fig. 8)

Chironomus binotatus Kieffer, 1911b:354 (junior homonym of *Ch. binotatus* Wiedemann, 1817).
Chironomus seychelleanus Kieffer, 1911b:356 (part) (junior synonym of *Chironomus callichirus* Kieffer, 1911b); (part) = *Ch. binotatus* Kieffer, 1911b.
Chironomus (*Dicrotendipes*) *binotatus* Kieffer: Freeman 1957:367.
Dicrotendipes binotatus (Kieffer): Freeman and Cranston 1980:190.

See Freeman (1957) for the description of the adult; the immature stages are unknown.

Chironomus seychelleanus was described from a male and a female (Kieffer 1911b). Freeman (1957:341, 367) found that the male was a *Ch. callichirus* Kieffer and the female a *D. binotatus.* I have examined Kieffer's female specimen; it is a *Dicrotendipes* and has at least 2 ventral accessory setae on S VI. It matches the holotype male of *Ch. binotatus,* which I also examined, in coloration, and probably is the female of this species. Freeman (1957:341) fixed the male specimen of *Ch. seychelleanus* as the lectotype; by page priority he considered it a junior synonym of *Ch. callichirus.* He

(Freeman 1957:368) listed the female as a "cotype"; it automatically became a paralectotype of *Ch. seychelleanus* (ICZN, Art. 73(b)(ii)). Because *Ch. binotatus* Kieffer, 1911 is a junior homonym of *Ch. binotatus* Wiedemann, 1817 (now considered the type-species of *Krenopelopia* Fittkau; see Fittkau 1962:262), and *Ch. seychelleanus* Kieffer is not available for this species, a new name must be given this species. I am happy to name this species for Dr. Paul Freeman, in recognition for the work he has done on the African chironomid fauna.

Dicrotendipes freemani is very similar to *D. chambiensis* (Goetghebuer). These may be the same species, but without a comparison of the immature stages of the 2 species I cannot consider synonymizing them.

The superior volsella of this species (Figs. 8A, B) also resembles that of the Holarctic *D. nervosus* (Staeger) and/or the Indo-Pacific *D. flexus* (Johannsen). Again, reared specimens are needed to confirm species relationships. See also remarks under *D. chambiensis.*

MATERIAL EXAMINED: ETHIOPIA: Bahar Dar, Tana-See, 26-I-1977, 1 male (ZS). [SEYCHELLES ISLANDS]: La Reunion: St. Pierre Villa, 5-I-1956, J.Hamon, 1 male (BM); Mahé, '08-9, Seychelles Exp., 1 male, 1 female (holotype male of *binotatus* and paralectotype female of *seychelleanus*) (BM) (Kieffer (1911b) lists the locality data for both specimens as: "Seychellen, Mahé: marshes on coastal plain at Anse aux Pins and Anse Royal, 19-21-I-1909.")

Dicrotendipes fusconotatus (Kieffer) (Fig. 10)

[?] *Dicrotendipes trilabis* Kieffer, 1922:63.
Calochironomus fusconotatum Kieffer, 1922:68.
Calochironomus griseonotatus Kieffer, 1922:69.
Calochironomus griseosparsus Kieffer, 1922:69.
Dicrotendipes forficula Kieffer, 1925:298.
Dicrotendipes nilicola Kieffer. 1925:300.
Polypedilum quatuorpunctatum Goetghebuer, 1936:489.
Dicrotendipes fusconotatus (Kieffer): Freeman 1955a:22; Dejoux 1977:293; Freeman and Cranston 1980:190; Reiss 1986:159; Contreras-Lichtenberg 1986:717.
Chironomus (*Dicrotendipes*) *fusconotatus* (Kieffer): Freeman 1957:362; Dejoux 1968:56.

See adult description in Freeman (1957:362) and Contreras-Lichtenberg (1986:718). There are no ventral accessory setae apparent on S VI. Contreras-Lichtenberg (1986) also described the pupa and larva of *D. fusconotatus.* I cannot reliably distinguish the pupa of *D. fusconotatus* from *D. pallidicornis* Goetghebuer, *D. peringueyanus* (as described by Contreras-Lichtenberg 1986) or *D. sudanicus.* Characters given in couplets 7 and 8 of Contreras-Lichtenberg's (1986) pupal key will not separate these species (the number of T II hooklets given for *D. fusconotatus* is very low; see description below); see also remarks under *D. peringueyanus* below.

I follow Freeman (1957) in listing *D. trilabis* as a probable synonym; the type is apparently lost and the description of the species appears to be that of a teneral *D. fusconotatus*. Kieffer described *fusconotatus* as 4 different species in one paper (Kieffer 1922) and as 2 more species in a later paper (Kieffer 1925).

PUPA: (n = 4)

COLOR. Very light brown, with light brown along lateral margins of tergites.

LENGTH. Total 4.08–4.90 mm (2).Cephalothorax 0.95–1.20 mm (2). Abdomen 3.13–3.69 mm (2).

CEPHALOTHORAX. Cephalic tubercles well developed (Fig. 10A). Dorsum moderately to well pebbled. Dc_2 closer to Dc_3. Thoracic horn base (Fig. 10B) with tracheal bundles separate.

ABDOMEN (Fig. 10C). Sternites II-III with fine lateral shagreen bands; also fine spinules scattered over S II-III; T I with posterolateral weak to well-developed reticulate pattern; T II with median quadrilateral shagreen area; T III-V with larger median quadrilateral shagreen area, areas somewhat extended laterally on anterior and/or posterior portion; T VI with V shaped shagreen area; T VII with an anterior pair of suboval shagreen areas; T VIII with a pair of longitudinal bands of fine shagreen; shagreen areas of T II-VI with spines larger in middle and posterior portion of area. Weak shagreen present dorsally on anal lobe. Tergites III-V with posterior conjunctival band of fine spinules; T VI-VIII with well developed reticulate cuticular pattern posterolaterally. Posterior margin of T II with transverse row of 59–68, 58 hooklets (40 in Contreras-Lichtenberg (1986)). T VIII with 5 lateral setae. Caudolateral spurs on T VIII (Figs. 10D, E) single or multiple, very small. Anal lobes with 61–78 setae (3), partially biserial. DR 2.35–2.64 (3).

FOURTH INSTAR LARVA: (n = 7)

COLOR. Head capsule light brown to brown, mentum and mandibular apodemes darker, sometimes with darker area anterior to postocciput; postocciput dark brown-black.

HEAD. Postmentum length 215–253, 234 (6). Mandible (Figs. 10F, G) length 203–223, 212 (6), with second and third lateral teeth partially fused, a shallow to deep incision proximal to these, followed by a fourth lateral tooth or "hump"; 2 well developed dorsal teeth present. Pecten mandibularis composed of 11–15, 12 (6) setae. Mentum (Fig. 10H) with 13 teeth, 5th and 6th teeth fused or closely appressed; width 133–143, 139 (6); MR 2.51–2.64, 2.59 (6). Ventromental plate with crenulate anterior margin; width 99–106, 103 (6); length 40–50, 45. VPR 2.10–2.50, 2.30 (6); IPD 72–79, 75 (6); PSR 1.27–1.44, 1.37 (6); 20–22, 21 strial ridges. Length of antennal segments: 64–79, 69 (5); 16–19, 18 (4); 11–12, 11 (5); 12–14, 13 (5); 6–7, 6 (5). AR 1.28–1.49, 1.40 (4) (Fig. 10I). Inner blade of premandible (Fig. 10J) greater than outer blade. Pecten epipharyngis (Fig. 10K) with 3–5, 5 (6) lobes. Anterior margin of frontal apotome (Fig. 7D) with long, thin ventral frontal process; labral sclerite 1 smooth. S I with 6–9, 7 fringes (Fig. 10L).

BODY. Ventral tubuli absent.

MATERIAL EXAMINED: "CONGO BELGE": Ishango bae, 20-II-1954, J. Verbeke—KEA, 1 male (BM); P.N.A. Vitshumbi (S. Lac. Ed.), 12-14-I-1953, J. Verbeke-KEA, 4 males (BM). EGYPT: Lake Nasser, El Madin, 7-XI-1971, M. Gillies, 1 male (BM); Lake Nasser, Nubia, 9-11-I-1981, P.S. Cranston, 2 males (BM). KENYA: Lake Beringo, Yellow Kay, XII-1977, Waddesdon School Exp., 1 female (BM). SUDAN: Abu Hamed, March 1948, 1 male (US). Blue Nile, Ummbenane nr Singa, light trap, 19-IV-1981, P. Mellor, 1 male (BM). Khartoum, 24-I-1953, D.J. Lewis, 2 males (BM). Wad Medani, Feb. 1952, D.J. Lewis, 1 male (BM). White Nile, Kalakla, 20 km S Khartoum, to light, I-1980, P.S. Cranston, 4 males, 1 female (BM). White Nile, Jebel Aulia, I-1980, P.S. Cranston, 1 male/Pex/Lex, 1 pharate male pupa/Lex, 2 males, 1 female/Pex 1 pharate female pupa, 5 larvae (BM).

Dicrotendipes kribiicola (Kieffer) (Fig. 11)

Phytochironomus kribiicola Kieffer, 1923:152.
Chironomus (*Dicrotendipes*) *kribiicola* (Kieffer): Freeman 1957:368; Dejoux 1968:57.
Dicrotendipes kribiicola (Kieffer): Freeman and Cranston 1980:190; Hare & Carter 1987:70.

See adult description in Freeman (1957:368); the type is apparently lost. There are 4–5 ventral accessory setae on S VI.

Freeman and Cranston (1980:190) erroneously listed *Polypedilum* as the genus in which this species was originally placed. The record from Nigeria is the first record of this species from that country.

I also examined a male specimen from Lake Kainji in Nigeria (in the BM collection) which superficially resembles *D. kribiicola,* differing mainly in the shape of the superior volsella. This specimen may represent a new species, but is in too poor condition to allow sufficient description.

PUPA: (n = 7)

COLOR. Light brown, with darker areas along lateral margins of tergites.

LENGTH. Total 3.92 mm (1). Cephalothorax 0.94—0.96 mm (2). Abdomen 2.70–3.17, 2.96 mm (5).

CEPHALOTHORAX. Cephalic tubercles well developed (Fig. 5A), 40–53, 49 (3) high, 60–105, 88 (3) wide. Dorsum moderately pebbled. Dc_2 closer to Dc_3. Thoracic horn base (Fig. 5B) with tracheal bundles fused medially or very closely appressed.

ABDOMEN (Fig. 11C). Sternites I-III with fine shagreen. Tergite I sometimes with weak lateral shagreen areas; T II-V with median quadrilateral shagreen area; T VI with a pair of median triangular shagreen areas, areas sometimes narrowly joined; T VII with anterior band of fine shagreen or a pair of anterolateral ovoid shagreen areas; T VIII with an anterior pair of ovoid fine shagreen areas and a smaller posterior pair of ovoid shagreen areas of these two areas joined in a pair of lateral bands; shagreen areas on T II-VI with spines larger in middle of area. Tergites III-V or IV-V with posterior conjunctival band of fine spinules; T V posteriorly with 2 groups of intersegmental spines, 2–4 spines in each group. Posterior margin of T II with transverse row of 52–68, 63 hooklets. T VIII with 5 lateral setae. Caudolateral spurs on T VIII (Fig. 11D) single or multiple, small to thorn-shaped. Anal lobes with 28–39, 36 setae. DR 1.50–2.41, 1.83.

FOURTH INSTAR LARVA: (n = 4)

COLOR. Head capsule light yellow-brown, postmentum darker brown; postocciput, mentum and mandibular apodemes dark red-brown.

HEAD. Postmentum length 180–195, 190 (3). Mandible (Fig. 11E) length 157–165, 160 with 3 lateral teeth; 2 well-developed dorsal teeth present. Pecten mandibularis composed of 9–10, 9 setae. Mentum (Fig. 11F) with apparently only 11 teeth, 5th and 6th teeth fused, 4th closely appressed; width 105–115, 110 (3); MR 2.10–2.20, 2.16 (3). Ventromental plate with smooth anterior margin; width 78–85, 83; length 38–43, 42. VPR 1.81–2.24, 1.99; IPD 41–45, 43 (3); PSR 1.81–2.07, 1.91 (3); 24–28, 25 strial ridges. Length of antennal segments: 54–61, 57; 18–20, 19; 9–10, 9 (3); 12–14, 13 (3); 4–5, 5 (3). AR 1.17–1.29, 1.23 (3) (Fig. 11G). Inner blade of premandible (Fig. 11H) subequal to outer blade. Pecten epipharyngis (Fig. 11I) with 5 lobes. Frontal apotome (Fig. 11J) with large ventral mesal ovoid pit; labral sclerite 1 smooth, reduced, much broader than long. S I with 6–9 (2) fringes.

BODY. Ventral tubuli absent.

MATERIAL EXAMINED: GHANA: Accra, J.D. Thomas, 12 males (BM). NIGERIA: Lake Opi nr Nsukka, mass rearing, 16-22-X-1977, leg. L. Hare, 1 male/Pex, 1 Pex; same locality, light trap, 31-XII-1978–1-I-1979, leg. L. Hare, 1 male (LH); same locality, mass rearing, 14-25-I-1979, leg. L. Hare, 2 males/Pex (LH); same locality, 28-I-3-II-1979, leg. L. Hare, 1 female/Pex/Lex (LH); same locality, 10-11-III-1979, leg. L. Hare, 1 female/Pex/Lex (LH); same locality, 22-IV-1979, leg. L. Hare, 3 larvae (LH); same locality, emergence trap, 24-25-XI-1979, leg. L. Hare, 1 male/Pex (LH). [ZAIRE]: "Congo Belge," Eala, I-1935, J. Ghesquiere, 1 male (BM).

Dicrotendipes leucolabis Kieffer

Dicrotendipes leucolabis Kieffer, 1922:65; Freeman and Cranston 1980:190.
Polypedilum (?) *aequatoris* Goetghebuer, 1936:482.
Chironomus (*Dicrotendipes*) *leucolabis* (Kieffer): Freeman 1957:367.

See adult descriptions in Kieffer (1922:65), Goetghebuer (1936:482) and Freeman (1957:367); immature stages are unknown.

This species may be a senior synonym of *D. collarti.* However, the type of *leucolabis* is probably lost and Kieffer's figure (1922: Fig. 67) of the hypopygium is insufficiently clear. Freeman (1957) synonymized *Polypedilum aequatoris,* known only as a female, with this species on the basis of wing maculation and body coloration. Kieffer's (1922) description of the wing of *D. leucolabis* does seem to match that illustrated for the female *aequatoris* specimen (Goetghebuer 1936:Fig. 35). The wing pattern of *leucolabis* differs from that of *collarti:* the transverse band is adjacent to RM and FCu in *collarti* and more distal in *leucolabis;* also the quadrate spot over the anal vein is smaller in *collarti.* These differences may be variations within one species; reared associations would have to be examined to determine whether 1 or 2 species are present.

Goetghebuer (1936) was apparently unsure of the generic position of this species, which he denoted with a parenthetical question mark following the genus name; Freeman examined the type and considered it a *Dicrotendipes* on the basis of tibial spurs. I have not seen any specimens of *D. leucolabis.*

Dicrotendipes nigrolineatus (Freeman)

Chironomus (*Dicrotendipes*) *nigrolineatus* Freeman, 1957:370.
Dicrotendipes nigrolineatus (Freeman): Freeman and Cranston 1980:190.

See adult description in Freeman (1957:370); immature stages are unknown. This species may be an *Einfeldia;* examination of reared immature stages is necessary for correct placement. There are no ventral accessory setae apparent on S VI.

MATERIAL EXAMINED: [ZAIRE]: "Belgian Congo": Elisabethville, 17-31-XII-1932, C. Seydel, 3 females (paratypes) (BM); same locality & collector, II-1933, 1 female (paratype) (BM); same locality & collector, 1-12-III-1933, 1 male (holotype) (BM).

Dicrotendipes peringueyanus Kieffer

Dicrotendipes peringueyanus Kieffer, 1924:257; Freeman 1955b:372; Disney 1975; Reiss 1977b:91, 93; Freeman and Cranston 1980:190; Prat 1981:58; Contreras-Lichtenberg 1986:706.
Polypedilum griseovittatum Goetghebuer, 1936:485.
Chironomus (*Dicrotendipes*) *peringueyanus* (Kieffer): Freeman 1957:364; Dejoux 1968:57.

See adult description in Freeman (1957:364) and Contreras-Lichtenberg (1986:707); the pupa has been described by Contreras-Lichtenberg (1986:706); the larva is unknown. There were no ventral accessory setae present on the males I examined.

This species may be a variant of *D. fusconotatus.* The genitalia are similar and the 2 species differ only slightly in wing maculation (see Freeman 1957). Without associated larval stages a decision regarding the status of the 2 species cannot be made.

Disney (1975) reported the phoretic association of the immature stages of *D. peringueyanus* with the African river crabs *Potomanautes africanus* (A. Milne-Edwards) and *P. pobeguini* (Rathbun) in Cameroon. The chironomid identifications were based on larvae reared to adults. Disney placed this material in the BM (Disney, pers. comm.). However, this material could not be located recently (Cranston, pers. comm.).

The pupa of *D.peringueyanus* as described by Contreras-Lichtenberg (1986) is not separable from *D. fusconotatus, D. pallidicornis* or *D. sudanicus.* In her pupal key, Contreras-Lichtenberg (1986) separates *D. perigueyanus* from *D. pallidicornis* based on the absence of conjunctival spinules on *D. pallidicornis.* However, all specimens of *D. pallidicornis* which I have examined do possess these spinules.

MATERIAL EXAMINED: [CAMEROON]: Kumba, Mambonjese, [on] crab *P. africanus,* 13-V-1969, [Disney], 1 male hypopygium & leg, det. A.D. Harrison (BM). [SOUTH AFRICA]: Cape Prov: Upington, XI-1950, P. Brinck, 2 males (BM); Transvaal: Nelspruit, XI-1956-II-1957, G.H. Frank, 1 male (BM).

Dicrotendipes schoutedeni (Goetghebuer)

Chironomus (*Limnochironomus*) *Schoutedeni* Goetghebuer, 1936:465.
Chironomus (*Dicrotendipes*) *schoutedeni* Goetghebuer: Freeman 1957:370; Freeman 1961b:247.
Dicrotendipes schoutedeni (Goetghebuer): Freeman and Cranston 1980:190; Hare & Carter 1987:70.

See adult descriptions in Goetghebuer (1936:465) and Freeman (1957:370); the immature stages are unknown. The anal tergal bands are unusual for a *Dicrotendipes;* there are no apparent ventral accessory setae on S VI. I have not examined the holotype.

MATERIAL EXAMINED: [BENIN] "DAHOMEY": cercle de Porto Novo, GBE home, 7-12-54, J. Hamon, 1 male (BM). NIGERIA: Lake Kainji, A. Bidwell, 1 male (BM); Lake Opi nr Nsukka, light trap, 13-14-I-1979, leg. L. Hare, 1 male (LH).

Dicrotendipes septemmaculatus (Becker) (Figs. 12, 49)

Chironomus septemmaculatus Becker, 1908:77.
[?] *Chironomus* (*Prochironomus*) *punctatipennis* Kieffer, 1910:234. **NEW SYNONYMY.**
Dicrotendipes pictipennis Kieffer, 1913b:23; Freeman 1955a:22.
[?] *Tendipes punctatipennis* (Kieffer): Kieffer 1913a:138.
Dicrotendipes pilosimanus Kieffer, 1914:262; Freeman 1955b:372; Sublette and Sublette 1973:404; Reiss 1977b:93; Reiss 1978:75; Freeman and Cranston 1980:190; Reiss 1986:159; Contreras-Lichtenberg 1986:716; Chaudhuri & Guha 1987:27.
Dicrotendipes formosanus Kieffer, 1916:115; Sublette and Sublette 1973:403; Hashimoto et al. 1981:12; Sasa and Hasegawa 1983:320. **NEW SYNONYMY.**
Dicrotendipes formosanus var *frontalis* Kieffer, 1916:116.
Dicrotendipes speciosus Kieffer, 1924:256; Kieffer 1925:299.
Stictochironomus sexnotatus Goetghebuer, 1930:95.
Chironomus hirtitarsis Johannsen, 1932:534; Sublette and Sublette 1973:402. **NEW SYNONYMY.**
Polypedilum quatuordecimpunctatum Goetghebuer, 1936:48.
Dicranotendipes speciosus Kieffer: Kruseman 1949:254 (misspelling).
Chironomus (*Dicrotendipes*) *pilosimanus* (Kieffer): Freeman 1954b:19; Freeman 1957:360; Freeman 1961a:247; Freeman 1961b:694; Dejoux 1968:56 (misspelled as *pilosinamus*).
Chironomus (*Dicrotendipes*) *pilosimanus* subsp. *quatuordecimpunctatus* (Goetghebuer): Freeman 1957:361.
Dicrotendipes frontalis Kieffer: Sublette and Sublette 1973:403. **NEW SYNONYMY.**
[?] *Dicrotendipes punctatipennis* (Kieffer): Sublette and Sublette 1973:404; Chaudhuri & Guha 1987:27 (misspelled as *punctipennis*).
Dicrotendipes rajasthani Singh and Kulshrestha, 1977:233. **NEW SYNONYMY.**
Dicrotendipes hiritarsis (Johannsen): Guha et al. 1982:30; Chaudhuri & Guha 1987:27 (misspelling).
Dicrotendipes quatuordecimpunctatus (Goetghebuer): Contreras-Lichtenberg 1986:710. **NEW SYNONYMY.**
Dicrotendipes septemmaculatus (Becker): Cranston and Armitage 1988.

See adult descriptions in Freeman (1957:360; 1961b:694; as *pilosimanus*) and Contreras-Lichtenberg (1986:711, 716, as *pilosimanus* and *quatuordecimpunctatus*). There are no ventral accessory setae apparent on S VI.

Dicrotendipes septemmaculatus is one of the most widely distributed members of this genus in the world (Fig. 49). I have examined reared material from the Afrotropical, southern Palaearctic (Lebanon) and Australian

regions. Afrotropical pupae possess long, well developed cephalic tubercles; in the one reared Australian pupa examined, the cephalic tubercles are not as well developed. Cephalic tubercle length often varies greatly within species in other species of *Dicrotendipes*. Pupae of *D. septemmaculatus* are difficult to separate from *D. fusconotatus, D. pallidicornis, D. peringueyanus* and *D. sudanicus*. Shagreen patterns in all 5 species are similar, and T II hooklet counts and anal lobe setal numbers overlap. *Dicrotendipes septemmaculatus* possesses a relatively well developed humeral comb or ridge; however, the development of this structure varies intraspecifically. It is also present, although more weakly developed, in *D. fusconotatus* and *D. sudanicus*. In *D. septemmaculatus* and *D. sudanicus,* Dc_2 is closer to Dc_1 than to Dc_3; however, *D. septemmaculatus* generally is larger, possesses long, well developed cephalic tubercles (shorter, squatter in *D. sudanicus*) and generally has more anal lobe setae. I would consider specific identification of isolated pupal exuviae of these 5 species to be risky.

Wing spots are variable in *D. septemmaculatus*. They may be absent in teneral specimens, and the pair of spots in cell r_{4+5} is sometimes combined into one spot.

Based on Afrotropical material, Freeman (1957) considered *D. pilosimanus* (= *D. septemmaculatus*) to consist of 2 geographical subspecies, *D. p. pilosimanus* and *D. p. quatuordecimpunctatus* (Goetghebuer). These differ only in the presence (*D. p. pilosimanus*) or absence (*D. p. quatuordecimpunctatus*) of a fore metatarsal beard, and, as Freeman (1957) noted, intermediates occur. In all reared material made available to me for this study, the adults possessed a sparse to moderately developed beard on fore ta_2 and ta_3. The moderately developed beard on many specimens was at least as well developed as that on specimens in the British Museum collection determined as *D. p. pilosimanus*. Although some workers believe 2 species may be present, until more reared material of both "subspecies" is made available, I see little need to continue the usage of *quatuordecimpunctatus*. Fortunately, the discovery of the Becker type of *septemmaculatus* no longer necessitates the usage of the name *pilosimanus* and its subspecies (Cranston & Armitage 1988). I have examined the Becker female holotype specimen.

Cranston & Armitage (1988) also rediscovered the type of *Stictochironomus sexnotatus* Goetghebuer and considered the species to be a junior synonym of *D. septemmaculatus*. I have also examined the male lectotype specimen and concur.

I have listed *Ch. punctatipennis* Kieffer as a probable synonym of *septemmaculatus*. Kieffer's (1910) original description of *punctatipennis* lacked illustrations and for the most part described wing maculation. In a later redescription based on additional specimens, Kieffer (1913a) provided an

illustration of the hypopygium and more morphological details. In the second description (plate XI, Fig. 10, mislabeled as *Tendipes punctatissimus*), Kieffer stated (and illustrated) that the male of *punctatipennis* possessed 3 volsellae. Kieffer may have been mistaking the proximal arm of the deeply bifid inferior volsella (as in *septemmaculatus*) for a third volsella. However, without examining a male from this series, or the type series (if one exists), I can not be positive that Kieffer may have made such a mistake.

Some of the material redescribed as *Ch. punctatipennis* by Kieffer (1913a) came from the collection of E. Brunetti; Brunetti's collection is now with the British Museum. I examined 3 female specimens from Bosundhur (Bangladesh), leg. J.T. Jenkins, from that collection. Two are labeled "*Tendipes punctatipennis*" in what appears to be Kieffer's hand-writing; the third is labeled "*Chiron. punctatipennis* Kieffer." These females are to me inseparable from *D. septemmaculatus.*

The type or type series (if one exists) of *D. punctatipennis* and perhaps *D. semiviridis* (Kieffer, 1911) may be with the Zoological Survey of India, Calcutta. According to Dr. M. Datta, Zoological Survey of India (pers. comm., 12 Sept. 1986), specimens of *punctatipennis* (and *semiviridis*) are present in the collection, but "are in extremely miserable condition and are suggestive of not being mailed to anybody so as to save from further deterioration." Obviously, an on-site examination of these specimens by a competent chironomid worker will be necessary to clear up the taxonomy of *D. punctatipennis.*

I consider *D. formosanus* Kieffer to be a junior synonym of *D. septemmaculatus;* only minor differences in coloration had separated the 2 species, which I do not consider to be sufficient reason to maintain the separation. The type of *formosanus* was apparently destroyed in the 1956 fire at the Hungarian National Museum.

Hashimoto et al. (1981:12) designated a holotype and paratypes for *formosanus* from Thailand material. These designations are invalid (ICZN, Chapter XVI); holotypes and paratypes can not be designated by any other than the original author. Lectotypes and paralectotypes can not be designated from Thailand material either, because such types can only be designated from the original series. Perhaps a neotype could be designated, but because Hashimoto et al. (1981) is not a revisory work, such a designation could also be considered invalid.

PUPA: (n = 6)

COLOR. Light yellow-brown, with light brown along lateral margins of tergites.

LENGTH. Total 5.90–6.14, 5.98 mm (3). Cephalothorax 1.30–1.50, 1.41 mm (3). Abdomen 4.23–4.71, 4.49 mm (5).

CEPHALOTHORAX. Cephalic tubercles well developed (Fig. 6A), 210–250, 228 (3) high, 125–162, 139 (3) wide. Dorsum and frontal apotome moderately to well pebbled. Dc_2 closer

to Dc_1. Thoracic horn base (Fig. 6B) with tracheal bundles separate. Dorsal portion of humeral callus usually with moderately developed "comb" or ridge.

ABDOMEN. Similar to *D. fusconotatus* (Fig. 10C). Sternite I sometimes with very fine median shagreen spinules; sternites II-III with fine lateral shagreen bands; also fine spinules scattered over S II-III; Tergite I with posterolateral weak reticulate pattern; T II with median quadrilateral shagreen area; T III-V with larger median quadrilateral shagreen area, areas somewhat extended laterally on anterior and/or posterior portion; T VI with broadly V shaped shagreen area; T VII with an anterior pair of suboval shagreen areas, sometimes joined medially; T VIII with a pair of longitudinal bands of fine shagreen; shagreen areas on T II-VI with spines larger in middle and posterior portion of area. Well developed shagreen area present dorsally on anal lobe. Tergites III-V with posterior conjunctival band of fine spinules; T V-VIII with reticulate cuticular pattern posterolaterally, well developed on T VI-VIII. Posterior margin of T II with transverse row of 66–93, 79 hooklets. T VIII with 5 lateral setae. Caudolateral spurs on T VIII single or multiple, small (similar to *D. fusconotatus,* Figs. 10D, E). Anal lobes with 47–67, 57 setae, partially biserial. DR 2.25–3.03, 2.63.

FOURTH INSTAR LARVA: (n = 4)

COLOR. Head capsule light brown to brown, mentum and postocciput red-brown, with slight caudal darkening of postmentum.

HEAD. Postmentum length 240–253, 245. Mandible (Fig. 12C) length 220–240, 230, with three lateral teeth; 2 well developed dorsal teeth present. Pecten mandibularis composed of 10–12, 11 setae, apical seta very broad. Mentum (Fig. 12D) with 13 teeth, 1st and 2nd teeth fused or closely appressed; width 150–162, 153; MR 2.58–2.88, 2.71. Ventromental plate with mostly smooth anterior margin, sometimes with extremely shallow crenulations; width 100–109, 104; length 52–65, 55. VPR 1.72–2.04, 1.88; IPD 63–72, 67; PSR 1.47–1.63, 1.55; 27–29, 28 strial ridges. Length of antennal segments: 79–87, 84; 25–27, 26; 12; 15–18, 17; 6. AR 1.32–1.43, 1.39 (Fig. 12E). Inner blade of premandible (Fig. 12F) greater than outer blade. Pecten epipharyngis (Fig. 12G) with 5 lobes. Anterior margin of frontal apotome (Fig. 12H) with long, thin ventral frontal process; labral sclerite 1 smooth. S I with 8–10 (2) fringes.

BODY. Ventral tubuli absent.

MATERIAL EXAMINED: ALGERIA: Oued Bechar, 26-III-1955, leg. E.J. Fittkau, 1 male/Pex/Lex, 3 Pex (ZS). AUSTRALIA: New South Wales: Deniliquin, from egg mass #6, 6-I-1969, 1 male (JM). Northern Territory: Fogg Dam, 15 km NE Humpty Doo, at UV light, 5-X-1982, leg. J.K. Balciunas, J. Gillett, 5 males, 1 female (JB). Queensland: Charleville, light trap, 17-II-1969, leg. A.L. Dyce, 1 male (JM); Sandgate, 14-V-1974, leg. J. Martin, 1 male/Pex (JM); Somerset Dam edge, 80 mi N Brisbane, 8-VI-1968, leg. J. Martin, 1 male (JM). [BANGLADESH]: Khulna, Bosondhur, Ganges delta, on launch, 29-VII-1909, J.T. Jenkins, 3 females (BM) (*punctatipennis* specimens). BURMA: Shan State, Lnle Marsh, ½ mi N of Shwevanpye, on *Hydrilla,* 26-VI-1982, leg. J.K. Balciunas, 2 larvae (JB). CANARY ISLANDS: Tenerife, Puerto Orotava, "51307.8," 1 female (holotype of *Ch. septemmaculatus* Becker) (ZH). EGYPT: Luxor, 12-I-1981, leg. P.S. Cranston, 1 male (BM). INDIA: Karnataka: Bangalore, 20 May 1982, leg. J.K. Balciunas, M.C. Minno, 1 pharate female pupa (JB); Dasappaddodi Pond, 35.5 km WSW Bangalore, at UV light, 24-V-1982, leg. J.K. Balciunas, M.C. Minno, 1 female (JB); Medahalli Well, 15 km E of Bangalore, at UV light, 21-V-1982, leg. J.K. Balciunas, M.C. Minno, 3 males (JB); Nandi Hills, el. 1200 m, 5 Oct 1985, leg. C.W. & L.B. O'Brien, 1 male (FS). Kerala: Chalakuby, 32 km S Trichur, 10-X-1985, leg. C.W. & L.B. O'Brien, 1 male (FS). Mahar: Rahuri, Mula River, Oct. 17, 1985, leg. C.W. & L.B. O'Brien, 1 male (FS). West Bengal: Burdwan, 7-VII-1978, leg. S.K. Nandi, 1 male (BM); Malda, 4-IV-1975, 1 female (BM). INDONESIA: Java: Central Java, Jombor Lake, 10 km S Klaten, on *Hydrilla,* 28 Aug 1981, leg. J.K. Balciunas, 1 larva (JB). South Sulawesi: Lake Lampulung,

5 km NE Seng Kang, on *Hydrilla,* 3-IX-1982, leg. J.K. Balciunas, 1 larva (JB); same data, except at black light, 65 males (JB). Sumatra: Bay of Meat, Lake Toba, 10-IV-1929, 1 male (minus wing, hypopygium) (paratype *Ch. hirtitarsis*) (BM). ISRAEL: Beth Netufa, Sept 1968, leg. J. Kugler, 1 male (JM). JAPAN: Hamamatsu City, Sept–Nov. 1984, leg. H. Hashimoto, 3 males, 5 females (HH). LEBANON: Ammik, el. 850 m, 16-V-1982, leg. Z. Moubayed, 4 males, 2 females, 3 Pex (ZM); Baalbek, el. 1150 m, 18-X-1982, leg. Z. Moubayed, 1 male, 1 pharate male pupa, 1 pharate female pupa, 13 Pex (ZM); River Litani at Jib-Jennine, 1 female, 1 pharate female pupa, 8 Pex, 4 larvae (ZM). MALAGASY: Pr. Tanan, Ankeniheny River (28 °C) 4 km S Manjakatompo Forest Sta., 1-XI-71, G.F. & C.H. Edmunds, F. Emmanuel, 2 males (FS). MALAYSIA: Penang State: irrigation canal in Balik Pulau Village, on *Hydrilla,* Sept 7 1983, leg. J.K. Balciunas, 1 larva (JB). [NAMIBIA]: "S.W. AFRICA": Swakopmund, 26-30-I-1972, Southern African Exp., 2 males (BM). NIGERIA: Jos., 24-XI-1970, J.C. Deeming, 1 male, 2 females (BM). [SOUTH AFRICA]: Transvaal: Olifantsvlei, nr Johannesburg, 22-IX-54, A.D. Harrison, 1 male (BM); Jukskei River, nr Johannesburg, VII-1956, A.D. Harrison & B.R. Allansen, 1 male (BM). SPAIN: Algeciras, 1 male (lectotype of *Stictochironomus sexnotatus* Goetghebuer) (NM). SRI LANKA: 1975, leg. F. Schiemer, 1 male (ZS). [SUDAN]: W. Darfur: N. Jebel Murra, Kurra, 5600 ft, 4-VII-1932, M. Steele, 1 male (BM). UGANDA: L. Victoria, 21-VI-1950, W.W. Macdonald, 1 male (BM). YEMEN: San'a, ca. 7900 ft., at night, 10-15-X-1937, C. Rathjens, 1 male (BM). [ZIMBABWE] "N. RHODESIA": Salisbury, V-1956, E.T.M. Reid, 1 male (BM). [ZAIRE]: Elizabethville, XI-1933, C. Seydel, 1 male (BM); Elizabethville, 17-XII-1938, H.J. Bredo, 1 female (BM).

Dicrotendipes sudanicus (Freeman) (Fig. 12)

Chironomus (*Dicrotendipes*) *sudanicus* Freeman, 1957:365; Dejoux 1968:56.
Dicrotendipes sudanicus (Freeman): Dejoux 1977:294; Freeman and Cranston 1980:190; Dejoux 1984:161; Hare & Carter 1987:70.

See adult description in Freeman (1957:365). There are no ventral accessory setae apparent on S VI.

This species appears to be a diminutive *D. fusconotatus.* The hypopygia of the 2 species are basically identical. The adults of the species differ only in relative size and in wing maculation; the wing markings of *sudanicus* are "clouds" along and over the veins while *fusconotatus* possesses spots in the cells. The pupae differ slightly. The pupa of *fusconotatus* is larger, has more anal lobe setae (61–78) and Dc_2 is closer to Dc_3. The pupa of *sudanicus* is smaller, has fewer anal lobe setae (35–47) and Dc_2 is closer to Dc_1. The larval mentum of *D. sudanicus* is similar to *D. septemmaculatus* and has the 2nd lateral tooth fused/appressed to the 1st lateral tooth; in *D. fusconotatus* the 6th lateral tooth is fused/appressed to the 5th, and the 1st and 2nd lateral teeth are separate. Larvae also differ in size, *D. fusconotatus* being much larger, and in ventromental strial ridge counts (20–22 in *fusconotatus,* 27–29 in *septemmaculatus,* 22–26 in *sudanicus*). The pupal and larval data are based on a very small sample.

PUPA: (n = 5)

COLOR. Light yellow-brown, with light brown along lateral margins of tergites.

LENGTH. Total 3.21 mm (1). Cephalothorax 0.83 mm (1). Abdomen 2.38–3.10, 2.77 mm (3).

CEPHALOTHORAX. Cephalic tubercles well developed (Fig. 12J), 45–47 (2) high, 65–88 (2) wide. Dorsum moderately pebbled. Dc_2 closer to Dc_1. Thoracic horn base (Fig. 12K) with tracheal bundles separate.

ABDOMEN. Similar to *D. fusconotatus* (Fig. 10C). Sternite I with very fine median shagreen spinules; sternites II-III with fine lateral shagreen bands; also fine spinules scattered over S II-III; Tergite I with anteromedian weak reticulate pattern; T II with median quadrilateral shagreen area; T III-V with larger median quadrilateral shagreen area, areas somewhat extended laterally on anterior and/or posterior portion; T VI with broadly V shaped shagreen area; T VII with an anterior pair of suboval shagreen areas; T VIII with a pair of longitudinal bands of fine shagreen, or an anterior and posterior ovoid to reniform pair of fine shagreen areas; shagreen areas on T II-VI with spines larger in middle and posterior portion of area. Well developed shagreen area present dorsally on anal lobe. Tergites III-V with posterior conjunctival band of fine spinules; T VI-VIII with reticulate cuticular pattern posterolaterally well developed on T VI-VII. Posterior margin of T II with transverse row of 56–70, 63 hooklets. T VIII with 5 lateral setae. Caudolateral spurs on T VIII single or multiple, small (similar to *D. fusconotatus,* Figs. 10D, E). Anal lobes with 35–47, 40 setae. DR 2.50–2.69, 2.57.

FOURTH INSTAR LARVA: (n = 5)

COLOR. Head capsule light brown, mentum and postocciput red-brown; postmentum not darkened.

HEAD. Postmentum length 175–193, 182. Mandible length 163–165, 164 (3) with three lateral teeth; 2 dorsal teeth present. Pecten mandibularis composed of 8–10, 9 (4) setae. Mentum (Fig. 12L) with 13 teeth, 1st and 2nd teeth fused or closely appressed; width 100–110, 105 (4); MR 2.38–2.64, 2.51 (3). Ventromental plate with mostly smooth anterior margin, sometimes with extremely shallow crenulations; width 81–87, 83 (4); length 40–43, 41 (4). VPR 1.91–2.18, 2.03 (4); IPD 46–51, 49 (4); PSR 1.61–1.89, 1.69 (4); 22–26, 24 strial ridges. Length of antennal segments: 52–61, 57 (4); 14–16, 15 (4); 8–9, 9 (3); 13 (2); 6 (3). AR 1.21–1.39 (2) (Fig. 12M). Inner blade of premandible greater than outer blade. Pecten epipharyngis with 4–5, 5 lobes. Anterior margin of frontal apotome with long, thin ventral frontal process; labral sclerite 1 smooth. S I with 5–7, 6 fringes.

BODY. Ventral tubuli absent.

MATERIAL EXAMINED: MALAGASY: Pr. Tanan, Antanifotsy R. (20° C), at forest station, 31-X-71, G.F. & C.H. Edmunds, F. Emmanuel, 1 male (FS). NIGERIA: Kaduna, 19-X-1956, B. McMillan, 2 males (BM); Lake Opi nr Nsukka, light trap, 26-26-XI-1978, leg L. Hare, 1 female (CH). SUDAN: Adok, 21-XI-1953, 1 male (holotype) (BM); Leidnum nr Wau, III-IV-1955, E.T.M. Reid, 1 male (paratype) (BM); Melut, 17-XI-1953, E.T.M. Reid, 1 female (paratype) (BM). TANZANIA: U. Pangani Rv, Ngumba Ya Mungu Reservoir, emergence trap, 15-VIII-1973, R.G. Bailey, 1 male (BM). [ZIMBABWE?]: Lake Karibe, 1966, leg. A.J. McLachlan, 1 male, 6 Pex, 6 Lex (BM).

FIG. 8. Superior volsellae of some Afrotropical *Dicrotendipes*. A, B) *D. freemani*. C, D) *D. chambiensis*.

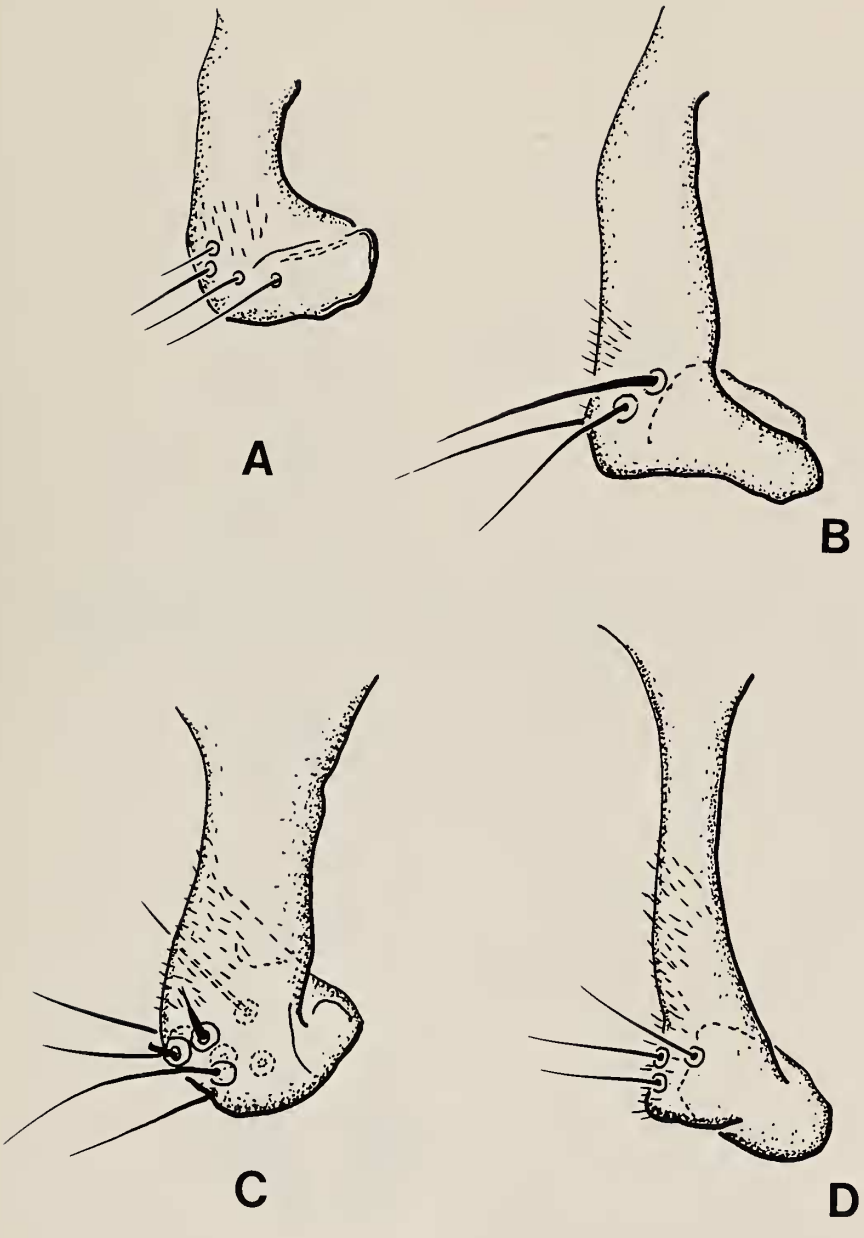

A
B
C
D

FIG. 9. *D. cordatus,* pupa. A) cephalic tubercles. B) Thoracic horn bases from 2 specimens. C) Abdomen, dorsal. D, E) Caudolateral spurs on T VIII.

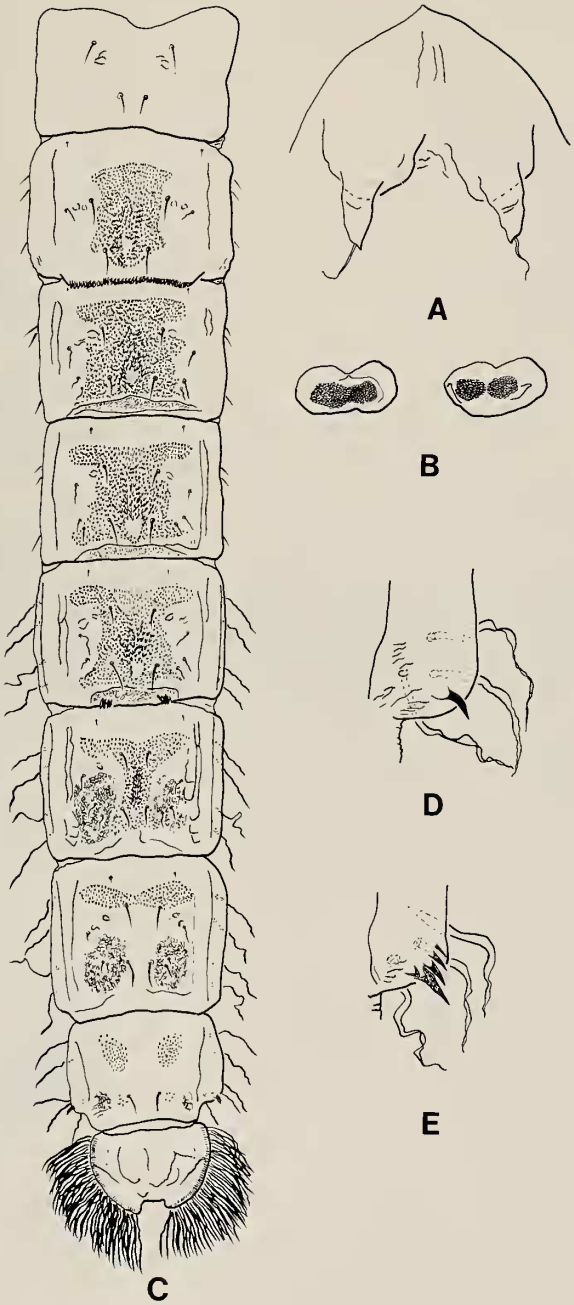
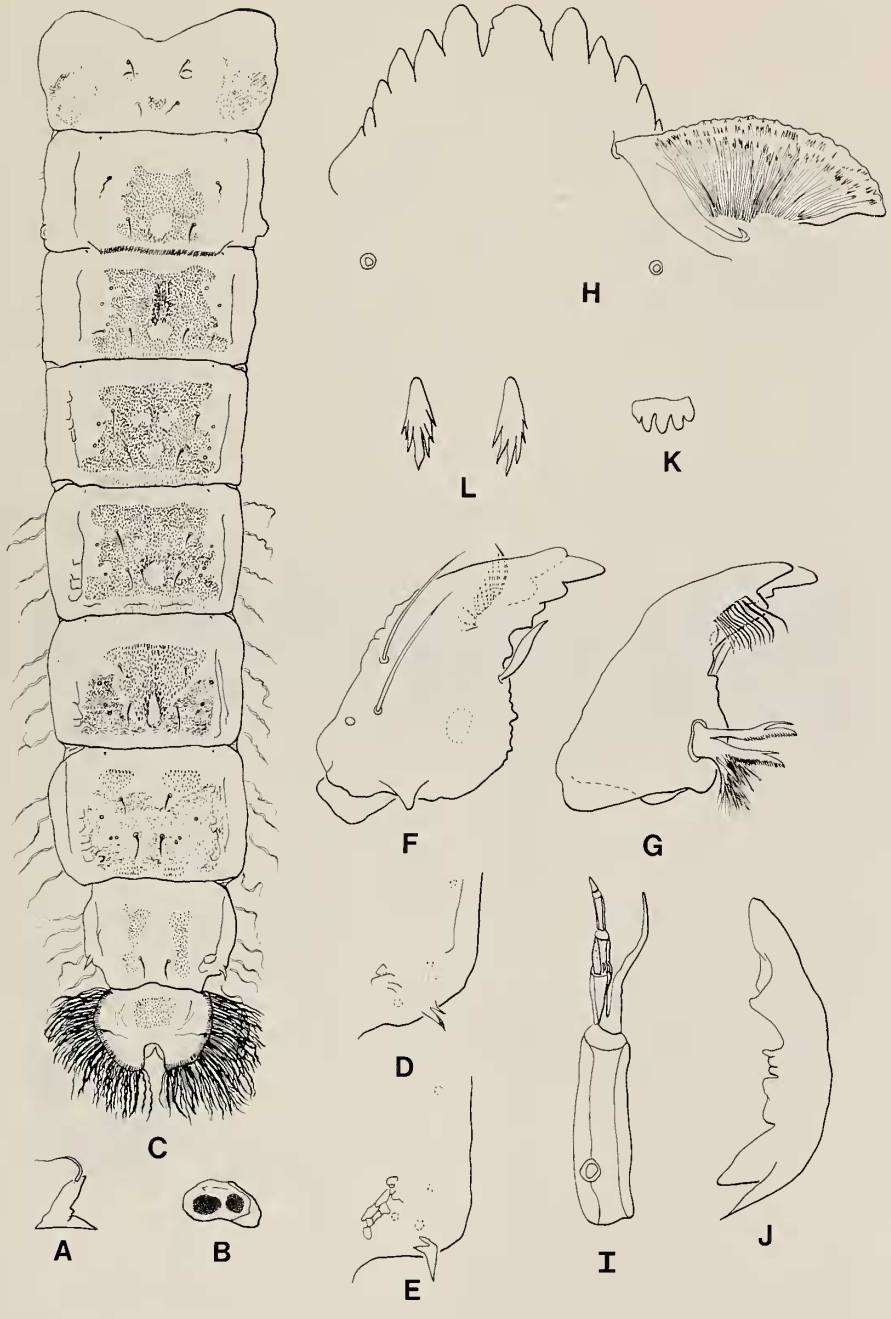

A
B
C
D
E

FIG. 10. *D. fusconotatus,* pupa (A–E) and larva (F–L). A) Cephalic tubercle. B) Thoracic horn base. C) Abdomen, dorsal. D, E) Caudolateral spurs on T VIII. F) Mandible, ventral. G) Mandible, dorsal. H) Mentum and ventromental plate. I) Antenna. J) Premandible. K) Pecten epipharyngis. L) S I.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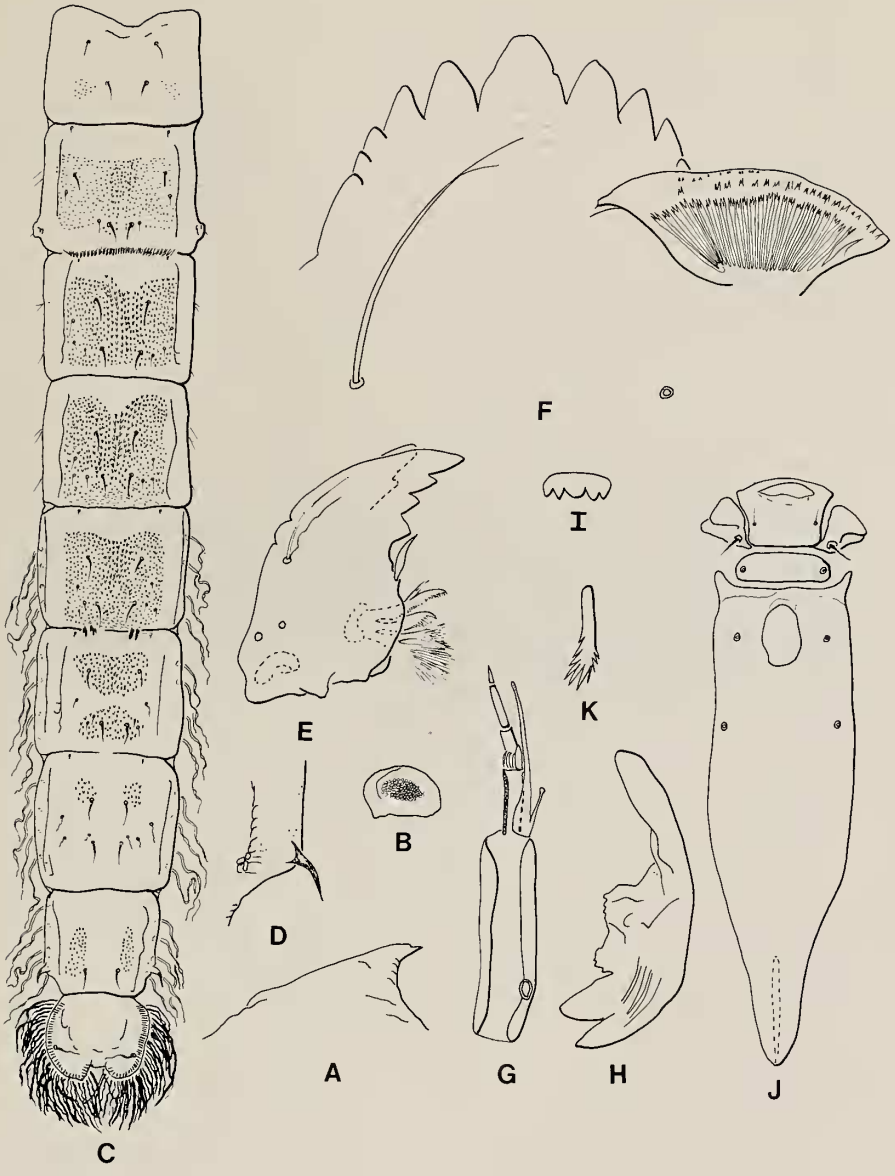
L

FIG. 11. *D. kribiicola,* pupa (A–D) and larva (E–J). A) Cephalic tubercle. B) Thoracic horn base. C) Abdomen, dorsal. D) Caudolateral spur on T VIII. E) Mandible, ventral. F) Mentum and ventromental plate. G) Antenna. H) Premandible. I) Pecten epipharyngis. J) Frontal apotome and labral sclerites. K) S I.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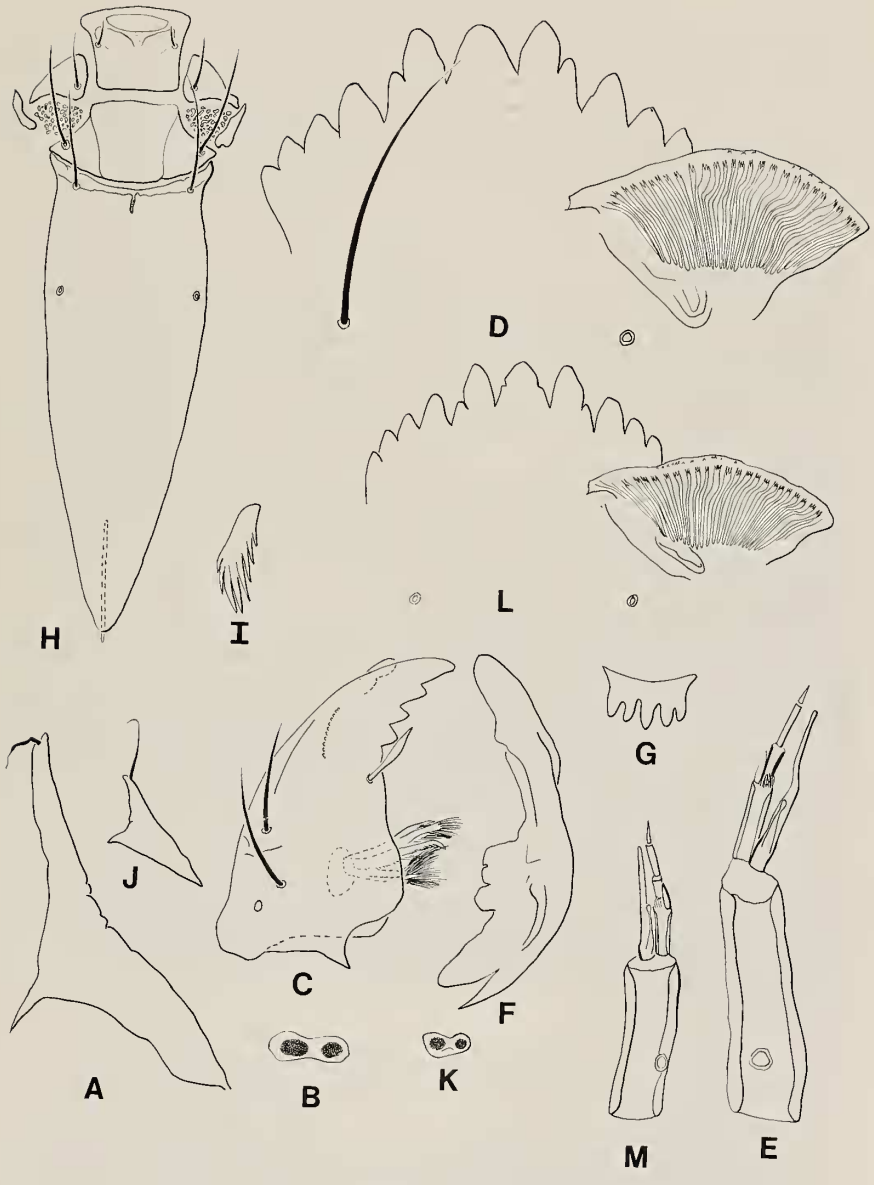
J

FIG. 12. *D. septemmaculatus,* pupa (A, B) and larva (C–I). A) Cephalic tubercle. B) Thoracic horn base. C) Mandible, ventral. D) Mentum and ventromental plate. E) Antenna. F) Premandible. G) Pecten epipharyngis. H) Frontal apotome and labral sclerites. I) S I. *D. sudanicus,* pupa (J, K) and larva (L, M). J) Cephalic tubercle. K) Thoracic horn base. L) Mentum and ventromental plate. M) Antenna.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Chapter III.
The Neotropical *Dicrotendipes*

With only a few exceptions (Brundin 1966; Edwards 1931; Reiss 1972, 1974), the Chironomidae of South America have not been studied in great detail. Reiss (1977a, 1982) has summarized the majority of papers dealing with the taxonomy of the family from South America.

The *Dicrotendipes* of the Neotropical region are poorly known. Rempel (1939:213) described a species from Brazil, *Chironomus* (*Calochironomus*) *atripennis,* which may be a *Dicrotendipes.* However, I have not seen any material of this species, and the description and figures are not sufficient to place this species in *Dicrotendipes.* Fittkau & Reiss (1979) listed one described and 10 undescribed species of *Dicrotendipes* from tropical and subtropical South America. To date, only 6 species have been described from the region (Paggi 1975, 1978, 1987; Epler 1987b). In this chapter, I review the known species, and supply descriptions for 10 new species, 9 of which are from the Amazon area.

It is unfortunate that the immature stages, especially the larvae, remain unknown for the majority of the species described here. As a result, the majority of the Neotropical species could not be used in the phylogenetic analysis (Chap. VI).

Many of the species from the Amazon area are quite bizarre, e.g., *D. soccus,* when compared with the Holarctic or Afrotropical fauna. All species from South America with deeply bifid inferior volsellae known to me possess palmate sensilla chaetica on the hind metatarsus. Such sensilla chaetica are lacking in Afrotropical forms with deeply bifid inferior volsellae (but are present in 2 species with simple inferior volsellae from the Oriental-Australasian region, and in one species from the Neotropics, *D. alsinensis*).

I have little doubt that more species of South American *Dicrotendipes* remain to be discovered and described. The following key must be considered as incomplete in this respect. Because the immature stages of Neotropical *Dicrotendipes* remain largely unknown, no keys are offered for their identification. Paggi (1987) offered a key for all stages of Argentinian *Dicrotendipes* known to her.

Key to Adult Males of Neotropical *Dicrotendipes*

1. Inferior volsella simple or at most deeply notched apically (Figs. 13-16); palmate sensilla chaetica absent on male hind metatarsus (except in *D. alsinensis;* see couplet 5) . 2
   Inferior volsella deeply bifid, each lobe well separated (Figs. 17, 19, 20, 24-27) or inferior volsella stout and extremely setose (Figs. 18, 23); palmate sensilla chaetica present on male hind metatarsus 7

2. Base of anal point raised, truncate, with more than 10 dorsal basal setae (Fig. 16) . . . . . *D. sinoposus* Epler
   Base of anal point not truncate; 7 or fewer dorsal basal setae 3
3. Superior volsella with short ventral, basal membranous flap (Fig. 22) . . . . . *D. palearivillosus* sp. nov.
   Superior volsella without membranous flap 4
4. Superior volsella cylindrical-digitiform with membranous apex 5
   Superior volsella pediform 6
5. Foretarsal beard well developed; gonostylus moderately heavy; superior volsella stout (Paggi 1975: Figs. 5, 8); with palmate sensilla chaetica on hind metatarsus . . . . . *D. alsinensis* (Paggi)
   Foretarsal beard absent; gonostylus thin; superior volsella thin (Fig. 13); without palmate sensilla chaetica on hind metatarsus . . . . . *D. aethiops* (Townes)
6. Superior volsella with elongate thin basal portion, "foot" narrow; inferior volsella deeply notched apically, lobes almost completely separated (Paggi 1978: Figs. 3, 5) . . . . . *D. nestori* Paggi
   Superior volsella with thicker basal portion, "foot" robust; inferior volsella shallowly notched or simple (Figs. 13-16) 7
7. Mid leg metatarsus very short, $SV_2 > 5.00$; inferior volsella simple; wings mostly clear (Paggi 1987: Figs. 2a, 6a) . . . . . *D. pellegriniensis* Paggi
   Metatarsus normal, $SV_2 < 5.00$; inferior volsella simple or slightly notched apically (Figs. 14-15); wings with faint markings at base of r_{4+5}, at FCu and along M_{3+4} and Cu_1 8
8. General coloration yellow-brown to brown; legs stramineous-brown, fore femora with darkened apices . . . . . *D. californicus* (Johannsen) complex (*D. californicus,* . . . . . *D. crypticus* Epler, *D. embalsensis* Paggi
   General coloration red-brown; legs dark brown, fore femora solid dark brown . . . . . *D. obrienorum* Epler
9. Inferior volsella stout, covered with long, dense setae 10
   Inferior volsella thin to moderate, without long, dense setae 11
10. Ventral portion of bifid superior volsella with sensilla chaetica (Fig. 18) (ventral portion of volsella is often difficult to discern) . . . . . *D. dasylabidus* sp. nov.
    Ventral portion of bifid superior volsella without sensilla chaetica (Fig. 23) (ventral portion of volsella is often difficult to discern) . . . . *D. paradasylabidus* sp. nov.
11. Base of anal point with ventral bulbous swelling (Figs. 17, 20, 24, 25). 14
    Base of anal point without ventral bulbous swelling (Figs. 19, 26, 27) 12
12. Disto-ventral portion of distal arm of inferior volsella with long sensilla chaetica; superior volsella slipper-shaped; posterior margin of T IX strongly cordiform-emarginate at base of anal point (Fig. 27). . . . . *D. soccus* sp. nov.
    Not as above. 13
13. Superior volsella deltoid-pediform in dorsal view (Fig. 26) . . . . . *D. reissi* sp. nov.
    Superior volsella elongate-cylindrical with pointed apex and dorsal basal lobe from which volsella is suspended (Fig. 19). . . . . *D. demissus* sp. nov.
14. Superior volsella bifid (Fig. 25) . . . . . *D. radinovskyi* sp. nov.
    Superior volsella not bifid 15
15. Superior volsella with acute apex directed caudad (Fig. 17) . . *D. amazonicus* sp. nov.
    Superior volsella deltoid-pediform or pediform (Figs. 21, 24). 16
16. Superior volsella pediform, apex directed laterad (Fig. 24) . . . *D. paterjohni* sp. nov.

Superior volsella deltoid-pediform, apex membranous and ventrally produced (may be directed mediad or laterad) (Fig. 20) . . . . . *D. fittkaui* sp. nov.

Previously Described Species

Dicrotendipes aethiops (Townes) (Figs. 13, 48)

Tendipes (*Limnochironomus*) *aethiops* Townes, 1945:107.
Tendipes (*Limnochironomus*) *figueroai* Vargas, 1952:48.
Dicrotendipes aethiops (Townes): Epler 1987a:30.

See Epler (1987a) for complete synonymy and description of adult male, and Epler (1987b) for additional distribution records. This species occurs in the southwestern United States and Mexico, and may occur farther south.

Dicrotendipes alsinensis (Paggi)

Chironomus (*Dicrotendipes*) *alsinensis* Paggi, 1975:149.
Dicrotendipes alsinensis (Paggi): Paggi 1978:235.

See Paggi (1975:149) for description of adult male, pupa and larva. To Paggi's (1975) description I can add the following data: Adult male: 12 cibarial setae; mid leg metatarsus with 10 palmate sensilla chaetica, hind metatarsus with 3 palmate sensilla chaetica; wing setae: R 18, R_1 7, R_{4+5} 4; no ventral accessory setae on S VI. Larva: 23 ventromental plate strial ridges, anterior margin of ventromental plate crenulated.

On the basis of superior volsella morphology (digitiform-cylindrical with a membranous apex), *D. alsinensis* would appear to be a member of the *D. nervosus* group as defined by Epler (1987a). However, Paggi's (1975:Fig. 12) pupal illustration does not indicate that the median shagreen area on T VI is V-shaped and the one pupal specimen I examined is damaged; T VI is not observable. Because the frontal apotome and labral sclerite 1 are not clearly visible on the larval exuviae associated with this pupal specimen (and they are not described by Paggi 1975), this species is difficult to place. It may be related to the *modestus* group, the *nervosus* group or *D. fumidus*. However, the one male of this species that I examined possesses palmate sensilla chaetica on the hind metatarsus; these sensilla chaetica are not present on any of the members of the aforementioned groups.

MATERIAL EXAMINED: ARGENTINA: Prov. Buenas Aires, Laguna Alsina, 27-III-1975, 1 male (IL); same locality, 27-IV-1975, leg. Paggi, 1 pharate male pupa/Lex (IL).

Dicrotendipes californicus (Johannsen) (Figs. 14, 47)

Chironomus californicus Johannsen, 1905:217.

See Epler (1987a) for full synonymies and descriptions of adult male, pupa and larva.

This species is widespread from California, southern Idaho and South Dakota in the U.S. south to Chile. Four other apparently closely related species have been described: *D. crypticus* Epler from New Mexico and California (Epler 1987a), *D. obrienorum* Epler from Mexico (Epler 1987b), and *D. embalsensis* Paggi and *D. pellegriniensis* Paggi from Argentina (Paggi 1987). These 4 species may only represent variants or ecotypes of *D. californicus*. More data are needed to clarify their status. See also discussions under each species below.

I have examined a single male specimen from the NM (collected at Finca Richter nr Bogotá, Colombia, by Lichtenberg) which may represent a new species. However, it is quite possible that this specimen is a *D. californicus* (or *D. obrienorum*) with deformed superior volsellae. I would have to see more specimens of this type before I could justify describing it as a new species.

There is minor variation in wing maculation over this species' range. A specimen from Peru has wing markings which are similar, but darker and more pronounced, than the typical *D. californicus*. See also comments under *D. pellegriniensis* below.

In addition to the material listed below, material from Costa Rica and Mexico has been examined (Epler 1987a).

MATERIAL EXAMINED: CHILE: Coquimbo, Punta Teatinos, 16-IX-1952, leg. P.G. Kuschel, 1 male (US); Santa Maria Fuadu [?], 28-I-1943, E. Melland, 1 male (BM). COLOMBIA: Palmira, Lichtfang [light trap], 25-I-1975, leg. Lichtenberg, 1 male (NM); Palmira, Finca Austria, b. Schwimmbecken, 26-I-1975, leg. Lichtenberg, 1 male (NM). PANAMÁ: Chiriquí Prov., Presa Fortuna, holding pond above Aoki camp, 3900′, light trap, 25-V-1985, leg. R.W. Flowers, 1 male (JE). PERU: Laguna de Medio Mundo, vegetation, brackish water of northern Peruvian coast, 17-IV-1975, leg. Gloria S. Minaya Gómez, 1 male, 1 larva (ZS).

Dicrotendipes crypticus Epler? (Fig. 47)

Dicrotendipes crypticus Epler, 1987a:39.

I have seen one larval specimen from South America which fits my concept of this species. The specimen possesses a head capsule with grainy integument, 27 ventromental plate strial ridges and a crenulate anterior margin

on the ventromental plate. This specimen may belong with *D. embalsensis*. The larvae of these 2 species appear identical, and the 2 species may prove to be synonyms. The date of publication of both Epler 1987a and Paggi 1987 is March 1987. Although *D. crypticus* was originally described in my thesis (Epler 1983), theses are not considered publications by the International Code of Zoological Nomenclature, Article 9 (1985). However, until more specimens of both species are examined, no decision can be made concerning their status.

MATERIAL EXAMINED: PARAGUAY: Rio Pilcomayo, 31-III-1974, leg. H. Sioli, 1 larva (ZS).

Dicrotendipes embalsensis Paggi

Dicrotendipes embalsensis Paggi, 1987:703.

See Paggi (1987:703) for description of adult male, pupa and larva. To her description I can add the following data: Adult male: 8 cibarial setae; mid leg metatarsus with 13–14 palmate sensilla chaetica, 0 on hind metatarsus; wing setae; squama 18–21, R 18, R_1 4, R_{4+5} 12; no ventral accessory setae apparent on S VI. Larva: 29–30 ventromental plate strial ridges, anterior margin of plate weakly and shallowly crenulated.

The key character of adult male frontal tubercle length used by Paggi (1987:697) will probably not separate *D. embalsensis* from *D. pellegriniensis*. The one specimen of *D. embalsensis* I examined lacked frontal tubercles. The length and presence or absence of frontal tubercles is extremely variable in all species of *Dicrotendipes* I have examined when sufficient material (usually more than 10 specimens) was available. The same would probably hold true for squamal setal counts (the one specimen I examined had a lower squamal setal count, 18, than recorded in the description or used in the keys). As adults, the 2 species can be separated by the short metatarsus and apparently clear wings of *D. pellegriniensis*. The characters used to separate the larvae of these 2 species in Paggi (1987) will probably also fail to separate them when more material is examined. Postmental darkening may be environmentally influenced (it apparently is in many Nearctic species; see Epler 1987a); and there probably is not a significant difference between a pecten epipharyngis with 5 teeth (*D. embalsensis*) and one with 6–7 teeth (*D. pellegriniensis*). More specimens of all species of the *D. californicus* complex must be examined in order to determine which characters, if any, will separate the species. It is possible that all of these species are nothing more than variants or ecophenotypes of *D. californicus*.

MATERIAL EXAMINED: ARGENTINA: Prov. Neuquén, Lago Ramos Mexia, 4-X-1983, leg. Kaisin, 1 male/Pex/Lex (IL).

Dicrotendipes nervosus (Staeger) group (Fig. 45)

I have seen several larval specimens from Brazil which conform to my definition of the *D. nervosus* group (cf. Epler 1987a). All of these specimens possess a pair of ventral tubuli on the eighth abdominal segment. It is possible that these larvae may belong with one or several of the species described as new below. Pupae are known for only 2 of these species, *D. fittkauii* and *D. soccus*. None of the pupal specimens examined possessed ventral tubule remnants on S VIII; these remnants should have been present had the larvae possessed ventral tubules. The pupae of both of these species possess a V-shaped median shagreen area on T VI, which would place them in the *D. nervosus* group. However, without associated larvae, such placement must be considered uncertain.

MATERIAL EXAMINED: BRAZIL: Amazonas: Lago do Calado, lower Rio Solimões, nr village Manacapurú, experimental box filled with wood wool as artificial substrate, exposed free floating at border of marginal floating meadows, Autumn 1968, leg. W. Junk, 1 larva (ZS). Pará: Lago Salgado, Cabaciera do boi, zw. Tabacorana-Wurzeln, 13-IV-1948, leg. Braun, 1 larva (ZS); same locality & collector, Aufwuchs auf Canaranca, 16-IV-1948, 1 larva (ZS).

Dicrotendipes nestori Paggi

Dicrotendipes nestori Paggi, 1978:235.

See Paggi (1978:235) for description of adult male, pupa and larva. To her description I can add the followng data: Adult male: 9 cibarial setae; mid leg metatarsus with 7 palmate sensilla chaetica, 0 on hind metatarsus; wing setae: R 19, R_1 7, R_{4+5} 12; no ventral accessory setae apparent on S VI.

I have not examined any larvae or pupae of this species. Because Paggi (1978) did not describe the immature stages completely, this species can not be placed phylogenetically.

MATERIAL EXAMINED: ARGENTINA: Prov. Buenas Aires, Laguna Alsina, 27-III-1975, 1 male (paratype) (IL).

Dicrotendipes obrienorum Epler (Figs. 15, 47)

Dicrotendipes obrienorum Epler, 1987b.

See description in Epler (1987b). Known only from Mexico, this species may be a lower latitude but higher elevation variant of *D. californicus.*

Dicrotendipes pellegriniensis Paggi

Dicrotendipes pellegriniensis Paggi, 1987:695.

See Paggi (1987:695) for description of adult male, pupa and larva. To her description I can add the following data: 10 cibarial setae; at least 14 palmate sensilla chaetica on mid leg metatarsus (not clearly discernible), 0 palmate sensilla chaetica on hind metatarsus; wing setae: R 16, R_1 6, R_{4+5} 9; no ventral accessory setae apparent on S VI. Larva: ventromental plate with 34 strial ridges, anterior margin of plate smooth.

The larvae and pupae of this species are morphologically inseparable from *D. californicus.* The adult male differs from *D. californicus* in the very short mid leg metatarsus which results in a very high SV_2 (6.46 in the one specimen made available to me), and perhaps in wing maculation. Paggi (1987) described the wings of this species as transparent, without spots. Unfortunately, in the one specimen of this species available to me, the mountant under the cover slip over the wings is unclear and the wings can not be viewed clearly. However, there appears to be a spot in the apex of cell r_{4+5}. I have found the amount or intensity of wing maculation to be variable in Nearctic specimens of *D. californicus;* thus, this character may not be of use in species separation within the *D. californicus* complex. The inferior volsella of *D. pellegriniensis* differs from that of typical *D. californicus* in that there is no trace of an apical indentation. This character is unreliable, however, for in many species the amount of apical indentation of the inferior volsella is variable. It is quite possible that *D. pellegriniensis* is but an ecophenotype of *D. californicus.* Paggi (1987) does not supply any physicochemical data for the collection sites of this species; perhaps an unknown pollutant could cause morphological changes which may produce a population of aberrant individuals, which may then be described as a "new species." More research is needed to solve the complexities of this problem.

MATERIAL EXAMINED: ARGENTINA: Prov. Rio Negro, Lago Pellegrini, 25, 26-III-1979, leg. Paggi, 1 male, 1 pupa/Lex (IL).

Dicrotendipes sinoposus Epler (Figs. 16, 48)

Dicrotendipes sinoposus Epler, 1987b.

See description in Epler (1987b). Originally described from Mexico, I have since examined more material from the Neotropics. These additional specimens enable me to add the following data to the original description: AR 2.22–2.70; 7–9 palmate sensilla chaetica on metatarsus of middle leg; 0–4 ventral accessory setae on S VI.

MATERIAL EXAMINED: BRAZIL: [Pará]: Rio Tocantins, nr village Jatobal, light trap, 5-XI-1960, leg. E.J. Fittkau, 1 male (ZS); Amazonas: Lago Cabaliana, lower Rio Solimões, drift, 16-VI-1971, leg. F. Reiss, 1 male (ZS). COLOMBIA: Arbeláez, light trap, 26-XI-1974, leg. Lichtenberg, 1 male; same locality & collector, 30-XI-1974, 1 male (NM). DOMINICA: Pont Casse, 1.5 mi. N, rain forest, 12 Feb 1965, leg. W.W. Wirth, Bredin-Archbold-Smithsonian Biol. Survey Dominica, 2 males (US).

New Species Descriptions

Dicrotendipes amazonicus sp. nov. (Fig. 17)

TYPE LOCALITY: Rio Tupani, lower Rio Madeira, Amazonas, Brazil.

TYPE MATERIAL: **Holotype:** male, BRAZIL: Amazonas: Rio Tupani, lower Rio Madeira, light trap, 14-15-IX-1960, leg. E.J. Fittkau (ZS). **Paratype**s (2572): same data as holotype, 2553 males, 13 females (ZS); lower Rio Madeira, Paraná Madeirinha, light trap, 12-IX-1960, leg. E.J. Fittkau, 4 males (ZS); Rio Tupani (wide, lake-like), light trap, 21-IX-1960, leg. E.J. Fittkau, 3 males (ZS); Upper Rio Tapajós, slightly downstream from mouth of Rio Juruena & Rio São Manuel, light trap at village Barra, 13-I-1961, leg. E.J. Fittkau, 1 male (ZS). Holotype to be deposited in IN; paratypes in ZS, JE.

DIAGNOSIS: The immaculate wings, deeply bifid inferior volsella, distinctive superior volsella and bulbous swelling beneath the anal point will distinguish this species.

ETYMOLOGY. This species is named for the Amazon region.

MALE IMAGO (n = 6)

COLOR (slide mounted specimens). Head, body and legs light brown. Wing immaculate, slightly dusky brown, with light brown veins.

LENGTH. Total 3.20–3.65, 3.33 mm. Thorax 0.72–0.82, 0.78 mm. Abdomen 2.43–2.85, 2.56 mm.

HEAD. Setae: temporal 22–32, 27; clypeal 10–14, 12; cibarial 7–8, 8 (4). Palpomere lengths: 27–40, 35; 35–40, 38; 70–88, 79; 106–113, 111; 148–180, 170 (4). Frontal tubercles 7–20, 12 long, 6–7, 7 wide (5). AR 2.03–2.15, 2.09 (3).

THORAX. Scutal tubercle well developed; humeral pit with 5–7 small tubercles. Acrostichals 6–9, 7; dorsocentrals 13–17, 15 (5); scutellars 7–8, 7; prealars 6–8, 7 (5).

WING. Length 1.28–1.40, 1.36 mm (5); width 0.39–0.41, 0.40 mm (5). FCu distal to RM. VR 0.85–0.88, 0.86 (5). Setae: brachiolum 2; squama 1–2, 2; R 12–16, 14; R_1 5–8, 7; R_{4+5} 9–14, 12.

LEGS. Foretarsal beard absent. Palmate sensilla chaetica: 5–9, 7 on middle metatarsus, 2–4, 3 on hind metatarsus. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	745-850, 789	620-700, 655	680-790, 727
ti	455-530, 486	540-610, 577	700-800 743
ta_1	1050-1170, 1109 (5)	310-365, 338	460-530, 497
ta_2	490-550, 519 (5)	140-170, 160	225-265, 247
ta_3	420-490, 456 (5)	100-120, 112	180-210, 197
ta_4	305-420, 388 (5)	45-50, 49 (5)	90-105, 98
ta_5	150-175, 168 (5)	50-55, 51 (5)	65-80, 76 (5)
LR	2.19-2.35, 2.26 (5)	0.57-0.61, 0.59	0.66-0.69, 0.67
BV	1.51-1.62, 1.57 (5)	4.09-4.41, 4.26 (5)	3.14-3.29, 3.19 (5)
SV	1.14-1.18, 1.16 (5)	3.55-3.76, 3.64	2.88-3.00, 2.96

ABDOMEN. 1–4 ventral accessory setae on S VI; 1 specimen seen with 1 ventral accessory seta on S V.

HYPOPYGIUM (Figs. 17A, B) with 2–5, 4 medial setae. Gonostylus normal, curved medially, with 4–7, 6 preapical setae. Superior volsella (Figs. 17C, D) length 50–72, 61 (4); width 27–30, 29 (4); LWR 1.9–2.6, 2.2 (4); slipper-shaped in dorsal view; with 4–5, 5 sensilla chaetica and fine setae on medial surface. Inferior volsella length 105–130, 117 (4); deeply bifid, with 3–5 sensilla chaetica in single row on proximal lobe, 4–5 sensilla chaetica in single row on distal lobe; distal lobe with 1 well developed ventral preapical seta. Anal point bare dorsally, with basal peduncle and bulbous ventral extension, weakly deflexed; with 1–2 dorsal basal setae and 6–13, 10 lateral basal setae.

FEMALE IMAGO (n = 3)

COLOR (slide mounted specimens). Similar to male.

LENGTH. Total 2.23–3.04, 2.56 mm. Thorax 0.74–0.81, 0.78 mm. Abdomen 1.42–2.30, 1.77 mm.

HEAD. Setae: temporal 22–23, 23; clypeal 11–14, 12; cibarial 7–10, 9. Palpomere lengths: 30–35, 33; 40–42, 41; 80–85, 83; 112–115, 115; 165–175, 170. Frontal tubercles 9–18, 12 long, 5–10, 7 wide. AR 0.47–0.55, 0.50.

THORAX. Scutal tubercle well developed; humeral pit with about 4 small tubercles. Acrostichals 9–10 (2); dorsocentrals 22–29, 25; scutellars 7–9, 7; prealars 6–8, 7.

WING. Length 1.49–1.55, 1.53 mm; width 0.47–0.51, 0.50 mm. FCu distal to RM. VR 0.82–0.89, 0.87. Setae: brachiolum 2; squama 1–4, 2; R 16–18, 17; R_1 11–16, 13; R_{4+5} 27–32, 29.

LEGS. Foretarsal beard absent. Palmate sensilla chaetica: 15–20, 17 on middle metatarsus, 5–7, 6 on hind metatarsus. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	790-800, 793	660-695, 675	745-790, 762
ti	500-520, 510	595-620, 606	745-790, 778
ta_1	1125-1240 (2)	355-370, 362	470-520, 493
ta_2	530-570 (2)	150-160, 157	225-250, 233
ta_3	450-510 (2)	105-110 107	180-195, 188
ta_4	430-560 (2)	45-50, 48	90
ta_5	190 (2)	50	70-75, 72
LR	2.25-2.43 (2)	0.60	0.62-0.65, 0.63
BV	1.47-1.51 (2)	4.44-4.64, 4.54	3.43-3.58, 3.49
SV	1.05-1.15 (2)	3.51-3.56, 3.54	3.06-3.19, 3.12

ABDOMEN. 2–4 ventral accessory setae on S VI. Notum 148–157, 153; cerci 72–90, 82. S VIII with 11–15 setae/side; X with 4–6, 5 setae; Gc IX with 1–2, 2 setae/side. DmL, VIL and ApL as in Fig. 17E.

Dicrotendipes dasylabidus sp. nov. (Fig. 18)

TYPE LOCALITY: Brazil, Amazonas, Upper Rio Solimões, Florianopolis.

TYPE MATERIAL: **Holotype:** male, BRAZIL: Amazonas: Upper Rio Solimões, Florianopolis, light trap, 15-VIII-1961, leg. E.J. Fittkau (ZS). Holotype to be deposited in IN.

DIAGNOSIS: The immaculate wings, stout, deeply bifid and densely setose inferior volsella, distinctive bifid superior volsella and cordiform-emarginate base of the anal point will distinguish this species.

ETYMOLOGY. From the Greek *dasys,* hairy and *labidos,* forceps; refers to the densely setose inferior volsella.

MALE IMAGO (n = 1)

COLOR (slide mounted specimens). Head, body and legs light brown. Wing immaculate, slightly dusky brown, with light brown veins.

LENGTH. Total 3.64 mm. Thorax 0.91 mm. Abdomen 2.73 mm.

HEAD. Setae: temporal 33; clypeal 11; cibarial 9. Palpomere lengths: 41, 47; 93; 115; 190. Frontal tubercles 6 long, 6 wide. AR 2.08.

THORAX. Scutal tubercle well developed; humeral pit indiscernible. Acrostichals 9; dorsocentrals 14; scutellars 10; prealars 8.

WING. Length 1.58 mm; width 0.47 mm. FCu distal to RM. VR 0.83. Setae: brachiolum 2; squama 2; R 15; R_1 6; R_{4+5} 11.

LEGS. Foretarsal beard absent. Palmate sensilla chaetica: 8 on middle metatarsus, 5 on hind metatarsus. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	855	710	830
ti	550	655	860
ta_1	1130	390	550
ta_2	530	190	280
ta_3	450	135	220
ta_4	400	50	100
ta_5	190	55	70
LR	2.05	0.60	0.64
BV	1.61	4.08	3.34
SV	1.24	3.50	3.07

ABDOMEN. Ventral accessory setae on S VI not apparent.

HYPOPYGIUM (Fig. 18A) with 4 medial setae. Gonostylus normal, curved medially, with 4 preapical setae. Superior volsella (Fig. 18B) bifid; length of dorsal portion 54, ventral portion 90; width of dorsal portion 11, ventral portion 30; dorsal portion small, digitiform, sclerotized, with 2 sensilla chaetica; ventral portion thin, lamellar, densely setose, with 2–4 sensilla chaetica. Inferior volsella length 135; deeply bifid, stout, with 4 sensilla chaetica each on proximal and distal lobes, densely setose on inner margin, with 1 well developed ventral preapical seta. Anal point cordiform-emarginate basally, bare dorsally; with 14 dorsal basal setae and 9 lateral basal setae.

Dicrotendipes demissus sp. nov. (Fig. 19)

TYPE LOCALITY: Brazil, Amazonas, Lago do Rei.

TYPE MATERIAL: **Holotype:** male, BRAZIL: Amazonas: Lago do Rei, Abends an bord bei Licht, 28-IX-1959, leg. Sioli-Settler (ZS). **Paratypes** (152): 132 males, 20 females, same data as holotype (ZS). Holotype to be deposited in IN; paratypes in ZS, JE.

DIAGNOSIS: The immaculate wings, deeply bifid inferior volsella and distinctive superior volsella will distinguish the male of this species. The immature stages are unknown.

ETYMOLOGY. From the Latin *demissus,* hanging down, drooping; refers to the superior volsella when viewed laterally.

MALE IMAGO (n = 7)

COLOR (slide mounted specimens). Head, body and legs light brown. Wing immaculate, slightly dusky brown, with yellow-brown veins.

LENGTH. Total 3.73–4.10, 3.85 (4) mm. Thorax 0.97–1.01, 0.99 (4) mm. Abdomen 2.73–3.15, 2.90 (6) mm.

HEAD. Setae: temporal 31-37, 36 (4); clypeal 15-21, 18 (6); cibarial 7-10, 9 (4). Palpomere lengths: 33-40, 38; 40-52, 46; 85-108, 97; 100-118, 111; 180-198, 189 (6). Frontal tubercles 20-28, 24 long, 8-10, 9 wide (5). AR 1.87-2.18, 1.96 (6).

THORAX. Scutal tubercle well developed; humeral pit 3-12 small to moderate tubercles. Acrostichals 5-12, 8; dorsocentrals 14-20, 18; scutellars 8-10, 9 (6); prealars 9-12, 10.

WING. Length 1.55-1.68, 1.63 mm (6); width 0.46-0.50, 0.48 (6) mm. FCu distal to RM. VR 0.85-0.87, 0.88 (5). Setae: brachiolum 2-3, 2; squama 2-3, 2; R 13-18, 15; R_1 5-10, 8; R_{4+5} 6-13, 10.

LEGS. Foretarsal beard absent. Palmate sensilla chaetica: 10-13, 11 on middle metatarsus, 7-11, 9 on hind metatarsus. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	880-960, 907	760-790, 773	855-890, 874
ti	580-625, 601	670-695, 685	870-910, 900
ta_1	1070-1100 (2)	380-410, 401	580-610, 589
ta_2	510-520 (2)	190-210, 203	295-310, 304
ta_3	440-450 (2)	135-155, 145	234-245, 240
ta_4	390-395 (2)	55-60, 59	120-130, 124
ta_5	180 (2)	60-70, 65	90-100, 96
LR	1.75-1.82 (2)	0.57-0.60, 0.59	0.64-0.68, 0.66
BV	1.69-1.70 (2)	3.78-4.10, 3.94	3.01-3.18, 3.10
SV	1.37-1.42 (2)	3.52-3.79, 3.63	2.92-3.10, 3.01

ABDOMEN. 5 ventral accessory setae on S VI.

HYPOPYGIUM (Figs. 19A, B) with 4-8, 6 medial setae. Gonostylus apically expanded, curved medially, with 5-6 preapical setae. Superior volsella (Fig. 19C) length 78-95, 85 (5); width 13-18, 16 (5); LWR 4.9-6.2, 5.5; elongate-cylindrical with pointed apex and a dorsal basal lobe from which volsella is suspended; dorsal portion with 2-3 sensilla chaetica, elongate suspended portion with 1 sensilla chaetica. Inferior volsella length 140-163, 153 (6); deeply bifid, with 2-4 sensilla chaetica in single row on proximal lobe, 2-5 sensilla chaetica in single row on distal lobe; distal lobe with 1 well developed ventral preapical seta. Anal point bare dorsally; with 3-6, 4 dorsal basal setae and 4-8, 6 lateral basal setae.

FEMALE IMAGO (n = 3)

COLOR (slide mounted specimens). Similar to male.

LENGTH. Total 3.28-3.84, 3.58mm. Thorax 1.08-2.63, 1.18 mm. Abdomen 2.20-2.58, 2.40 mm.

HEAD. Setae: temporal 31–41, 36; clypeal 27–33, 30; cibarial 5–10, 8. Palpomere lengths: 40–48, 44; 48–55, 52; 85–108, 97; 100–118, 111; 180–198, 189 (6). Frontal tubercles 12–15, 13 long, 11–17, 14 wide. AR 0.46–0.56 (2).

THORAX. Scutal tubercle well developed; humeral pit with 1 small tubercle. Acrostichals 11–14, 12; dorsocentrals 27–38, 31; scutellars 12–14, 13; prealars 10–12, 11.

WING. Length 1.76–1.94; 1.88 mm; width 0.60–0.68, 0.64 mm. FCu distal to RM. VR 0.83–0.85, 0.84. Setae: brachiolum 2–3, 2; squama 6–9, 7; R 24–31, 26; R_1 15–18, 16; R_{4+5} 23–28, 26.

LEGS. Palmate sensilla chaetica: 18–21, 20 on middle metatarsus, 16–18, 17 on hind metatarsus. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	910-1015, 975	780-960, 867	910-1000, 970
ti	630-705, 677	715-885, 787	940-1035, 1002
ta_1	—	430-465, 448	580-660, 627
ta_2	—	205-215, 208	295-320, 308
ta_3	—	140-150, 147	240-260, 250
ta_4	—	70	120-140, 132
ta_5	—	80	95-105, 102
LR	—	0.53-0.60, 0.57	0.62-0.64, 0.63
BV	—	3.89-4.49, 4.16	3.24-3.31, 3.28
SV	—	3.48-3.97, 3.68	3.08-3.19, 3.15

ABDOMEN. 2–8 ventral accessory setae on S VI. Notum 190–193, 191; cerci 110–130, 119. S VIII with 25–28, 27 setae/side; X with 8–9, 8 setae; Gc IX with 2–3, 3 setae/side. DmL, VlL and ApL as in Fig. 19D.

Dicrotendipes fittkaui sp. nov. (Figs. 20, 21)

TYPE LOCALITY: Brazil, Reserva Duke nr Manaus.

TYPE MATERIAL: **Holotype:** male/Pex, BRAZIL, Amazonas: Reserva Duke, nr Manaus, reared from a ground water puddle in the forest, 9-10-V-1961, leg. E.J. Fittkau (ZS). **Paratypes** (9): Brazil, Amazonas, Lago do Calado, from vegetation in central part of floating meadow, 10-VIII-1968, leg. W. Junk, 1 pharate male pupa (ZS); Lago do Calado, lower Rio Solimões,

nr village Manacapurú, experimental box filled with wood wool as artificial substrate, exposed free floating at border of marginal floating meadows, Autumn 1968, leg. W. Junk, 1 pharate male pupa (ZS); Lago Cabaliana, lower Rio Solimões, drift, leg. F. Reiss, 1 male (ZS). Pará: Alemquer, no porto, as 20 horas, na luz, 15-VII-1946, leg. Sioli, 4 males (ZS); Rio Cururú, Missão Cururú, right tributary of Rio Tapajós, light trap, 16-I-1961, leg. E.J. Fittkau, 2 males (ZS); same locality & collector, 19-I-1961, 1 male (ZS). Holotype to be deposited in IN; paratypes in ZS, JE.

DIAGNOSIS: The immaculate wings, deeply bifid inferior volsella, distinctive superior volsella, clavate gonostylus and bulbous swelling beneath the anal point will distinguish this species. The female and larva are unknown.

ETYMOLOGY. I take great pleasure in naming this species in honor of Prof. Dr. E.J. Fittkau.

MALE IMAGO (n = 6)

COLOR (slide mounted specimens). Head, body and legs light brown. Wing immaculate, slightly dusky brown, with yellow-brown veins.

LENGTH. Total 3.13–3.45, 3.32 (4) mm. Thorax 0.78–0.96, 0.85 (4) mm. Abdomen 2.35–2.65, 2.46 (5) mm.

	P_1	P_2	P_3
fe	820-850, 835 (4)	700-745, 721 (5)	770-810, 796 (4)
ti	520-560, 532 (5)	630-665, 646 (5)	810-830, 820 (2)
ta_1	1090-1140 (2)	350-360, 354 (5)	530-540, 533 (3)
ta_2	480-550 (2)	170-190, 179 (5)	250-270, 260 (3)
ta_3	400-485 (2)	115-130, 122 (5)	190-210, 202 (3)
ta_4	355-430 (2)	55-60, 57 (5)	100-110, 105 (3)
ta_5	160-175 (2)	55-60 58 (5)	80-85, 82 (3)
LR	2.06-2.19 (2)	0.54-0.57, 0.55 (5)	0.64-0.66, 0.65 (3)
BV	1.53-1.76 (2)	4.02-4.22, 4.14 (5)	3.22-3.39, 3.31 (3)
SV	1.20-1.25 (2)	3.71-3.92 3.86 (5)	3.00-3.08, 3.03 (3)

HEAD. Setae: temporal 29–35, 32 (4); clypeal 8–13, 12; cibarial 2–11, 8 (4). Palpomere lengths: 30–50, 37 (4); 38–45, 42 (4); 70–95, 81 (4); 105–115, 108 (3); 175–178, 177 (3). Frontal tubercles 8–20, 13 long, 5–8, 7 wide. AR 1.84–2.08, 1.94 (5).

THORAX. Scutal tubercle well developed; humeral pit 1–3 moderate tubercles. Acrostichals 6–11, 8 (5); dorsocentrals 15–20, 17 (4); scutellars 8–11, 9 (4); prealars 7–10, 9 (4).

WING. Length 1.30–1.55, 1.47 mm (5); width 0.37–0.43, 0.41 mm (5). FCu distal to RM. VR 0.86–0.89, 0.88 (5). Setae: brachiolum 2–3, 2; squama 1–3, 2 (5); R 14–18, 16 (5); R_1 7–9, 8 (5); R_{4+5} 7–15, 12 (5).

LEGS. Foretarsal beard absent. Palmate sensilla chaetica: 7–13, 10 (5) on middle metatarsus, 3–7, 5 (3) on hind metatarsus. Lengths and proportions of legs on p. 71.

ABDOMEN. Ventral accessory setae on S VI not apparent.

HYPOPYGIUM (Figs. 20A, B) with 3–7, 5 medial setae. Gonostylus apically expanded, curved medially, with 6–10 preapical setae. Superior volsella (Fig. 20C) length 45–58, 53 (3); width 33–43, 37 (3); LWR 1.3–1.7, 1.4 (3); semi-pediform, with ventral subapical lobe; with dorsal and ventral fine setae; with 1–4 small sensilla chaetica. Inferior volsella length 125–154, 142 (5); deeply bifid, with 3–5 sensilla chaetica in single row on proximal lobe, 5–6 sensilla chaetica in single row on distal lobe; distal lobe with 1 well developed ventral preapical seta. Anal point bare dorsally, with basal peduncle and bulbous ventral extension, deflexed; with 0–2 dorsal basal setae and 8–14, 10 lateral basal setae.

PUPA (n = 3)

COLOR. Clear with light brown margins.

LENGTH. Total 3.40 mm (1). Cephalothorax 0.42 mm (1). Abdomen 2.98–3.40, 3.20 mm.

CEPHALOTHORAX. Cephalic tubercles (Fig. 21A) 40–50 (2) high, 68–83 (2) wide. Dorsum moderately smoothly pebbled. Dc_2 closer to Dc_3. Thoracic horn base (Fig. 21B) with tracheal bundles separate.

ABDOMEN (Fig. 21C). Sternites I-IV with fine lateral shagreen bands; S V-VI with posterior areas of fine shagreen. Tergite I sometimes with small scattered posterolateral spinules; T II with T-shaped shagreen area, spinules largest posteriorly; T III-V with median quadrilateral shagreen area; T VI with triangular shagreen area, spinules largest mesally; T VII with an anterior pair of small ovoid shagreen areas; T VIII with a pair of longitudinal fine shagreen bands. Tergites IV and V with a posterior band of fine spinules; T V-VI with posterolateral group of fine spines. Posterior margin of T II with transverse row of 65–72, 68 hooklets. T VIII with 4 lateral lamellar setae. Caudolateral spurs on T VIII (Figs. 21D, E) single or double, moderately large. Anal lobes with 39–52, 46 setae. DR 1.69–2.09, 1.93.

Dicrotendipes palearivillosus sp. nov. (Fig. 22)

TYPE LOCALITY: Costa Rica, San Jose Queb. Muerte.

TYPE MATERIAL: **Holotype:** male, COSTA RICA: San Jose Queb. Muerte, route 2, 3.5 km (air) W Villa Mills, 9.652 N, 83.743 W, 12.vi.1986, el. 3120 m, Holzenthal, Heyn, Armitage (CU). **Paratypes** (2): same data as holotype, 1 male (CU); Heredia, Est. Biol. La Selva, Rio Puerto Viejo, 10.440 N, 84.012 W, 19-VI-1986, el. 30 m, Holzenthal, Heyn, Armitage, 1 male (CU). The holotype will be deposited in the US, one paratype in CU and the other in JE.

DIAGNOSIS: The immaculate wings, distinctive digitiform superior volsella with small membranous ventral basal lobe and simple inferior volsella will distinguish this species. The female and immature stages are unknown.

ETYMOLOGY. From the Latin *palear,* a flap or wattle, and *villosus,* hairy; refers to the basal lobe of the superior volsella.

MALE IMAGO (n = 2)

COLOR (slide mounted specimens). Head and body light yellow-brown (probably green in life); fore femora greenish-stramineous, apex of femur and remainder of leg light brown, mid and hind legs greenish-stramineous, apical tarsomeres darker. Wing immaculate, slightly dusky brown, with light yellow-brown veins.

LENGTH. Total 3.38–3.73 mm. Thorax 0.88–0.90 mm. Abdomen 2.50–2.83 mm.

HEAD. Setae: temporal 33–35; clypeal 18–20; cibarial 5–6. Palpomere lengths (1): 43; 43; 113; 143; 210. Frontal tubercles 2–4 long, 2–3 wide. AR 2.06–2.07.

THORAX. Scutal tubercle well developed; humeral pit indiscernible. Acrostichals 5–6; dorsocentrals, 15–17; scutellars 7–10; prealars 8–9.

WING. Length 1.70–1.73 mm; width 0.48–0.50 mm. FCu distal to RM. VR 0.87–0.89. Setae: brachiolum 2–3; squama 4–5; R 19; R_1 8–11; R_{4+5} 15–22.

LEGS. Foretarsal beard absent. Palmate sensilla chaetica: 4–8 on middle metatarsus, 0 on hind metatarsus. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	880-930	760-790	850-885
ti	760-680	700-710	920-940
ta_1	1190-1290	380-390	630-645
ta_2	530-540	200-210	295-310
ta_3	455-460	140	230
ta_4	400-410	70	120-130
ta_5	175-185	55-60	75-90
LR	1.78–1.90	0.54–0.55	0.68–0.69
BV	1.76–1.82	3.94–3.96	3.25–3.33
SV	1.25–1.30	3.84–3.85	2.81–2.83

ABDOMEN. 3–5 ventral accessory setae on S VI; one specimen with 1 ventral accessory seta on S VII.

HYPOPYGIUM (Fig. 22A) Gonostylus moderate, curved medially, with 4–5 preapical setae. Superior volsella (Fig. 22B) length 67–68, width 16–18; digitiform with bare, apparently slightly membranous apex and with basal membranous ventral lobe or flap covered with long, fine setae; with 4–6 ventromedial sensilla chaetica. Inferior volsella length 110–113; simply clubbed; with 3–4 dorsal sensilla chaetica in 2 rows, with 1 well developed ventral preapical seta. Anal point bare dorsally, on small peduncle, slightly deflexed; with 3–4 dorsal basal setae and 8 lateral basal setae.

Dicrotendipes paradasylabidus sp. nov. (Fig. 23)

TYPE LOCALITY: Brazil, Amazonas, upper Rio Solimões at mouth of Rio Takana.

TYPE MATERIAL: **Holotype:** male, BRAZIL: Amazonas: upper Rio Solimões at the mouth of Rio Takana (west of Rio Ica), light trap, 15-VIII-1961, leg. E.J. Fittkau (ZS). Holotype to be deposited in IN.

DIAGNOSIS: The immaculate wings, stout, deeply bifid and densely setose inferior volsella, distinctive bifid superior volsella and cordiform-emarginate base of the anal point will distinguish this species. Its small size and lack of sensilla chaetica on the ventral portion of the bifid superior volsella will distinguish this species from *D. dasylabidus.*

ETYMOLOGY. From the Greek *para,* near, *dasys,* hairy and *labidos,* forceps; refers to the inferior volsella and the apparent close relationship between this species and *D. dasylabidus.*

MALE IMAGO (n = 1)

COLOR (slide mounted specimen). Head, body and legs light brown. Wing immaculate, slightly dusky brown, with light brown veins.

LENGTH. Total 2.95 mm. Thorax 0.75 mm. Abdomen 2.20 mm.

HEAD. Setae: temporal about 30; clypeal 11; cibarial indiscernible. Palpomere lengths: 35; 35; 75; 102; 177. Frontal tubercles 5 long, 6 wide. AR 1.79.

THORAX. Scutal tubercle well developed; humeral pit indiscernible. Acrostichals 8; dorsocentrals 18; scutellars 8; prealars 10.

WING. Length 1.35 mm; width 0.39 mm. FCu distal to RM. VR 0.86. Setae: brachiolum 2; squama 1; R 14; R_1 5; R_4+_5 7.

LEGS. Foretarsi missing. Palmate sensilla chaetica: 7 on middle metatarsus, 2 on hind metatarsus. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	740	620	700
ti	470	545	720
ta_1	—	340	465
ta_2	—	160	230
ta_3	—	110	180
ta_4	—	45	90
ta_5	—	50	70
LR	—	0.62	0.65
BV	—	4.12	3.31
SV	—	3.43	3.05

ABDOMEN. 2 ventral accessory setae on S VI.

HYPOPYGIUM (Fig. 23A) with 17 dorsomedial setae. Gonostylus thin, slightly curved medially, with 3 preapical setae. Superior volsella (Fig. 23B) bifid; length of dorsal portion 42, ventral portion 49; width of dorsal portion 11, ventral portion 25; dorsal portion small, digitiform, sclerotized, with 2 sensilla chaetica; ventral portion thin, lamellar, densely setose, without sensilla chaetica. Inferior volsella length 133; deeply bifid, stout, with 4 sensilla chaetica each on proximal and distal lobes, densely setose on inner margin, with 2 well developed ventral preapical setae. Anal point cordiform-emarginate basally, bare dorsally; with 6–8 lateral basal setae.

Dicrotendipes paterjohni sp. nov. (Fig. 24)

TYPE LOCALITY: Brazil, Amazonas, lower Rio Preto da Eva.

TYPE MATERIAL: **Holotype:** male, BRAZIL: Amazonas: lower Rio Preto da Eva, left tributary of upper Rio Amazonas, village Tiririca, light trap, [no date], leg. E.J. Fittkau (ZS). Holotype to be deposited in IN.

DIAGNOSIS: The immaculate wings, deeply bifid inferior volsella, distinctive pediform superior volsella and bulbous swelling beneath the anal point will distinguish this species.

ETYMOLOGY. From the Latin *father,* pater. I take pleasure in naming this species for "Father John" Kramer, whose assistance, both direct and indirect, has helped make this study possible.

MALE IMAGO (n = 1)

COLOR (slide mounted specimen). Head, body and legs light brown. Wing immaculate, slightly dusky brown, with light brown veins.

LENGTH. Total 3.28 mm. Thorax 0.80 mm. Abdomen 2.73 mm.

HEAD. Setae: temporal indiscernible; clypeal 14; cibarial indiscernible. Palpomere lengths: 35; 40; 90; 117; 178. Frontal tubercles 10 long, 7 wide. AR 2.14.

THORAX. Scutal tubercle well developed; humeral pit indiscernible. Acrostichals 8; dorsocentrals 15; scutellars 8; prealars 9.

WING. Length 1.47 mm; width 0.40 mm. FCu distal to RM. VR 0.88. Setae: brachiolum 2; squama 2; R 16; R_1 6; R_{4+5} 9.

LEGS. Foretarsal beard absent. Palmate sensilla chaetica: 8 on middle metatarsus, 3 on hind metatarsus. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	865	710	780
ti	510	625	800
ta_1	1180	360	510
ta_2	550	165	265
ta_3	475	110	205
ta_4	415	50	105
ta_5	170	50	75
LR	2.31	0.58	0.64
BV	1.59	4.52	3.22
SV	1.17	3.71	3.10

ABDOMEN. Ventral accessory setae on S VI not apparent.

HYPOPYGIUM (Fig. 24A) with 2 medial setae. Gonostylus apically expanded, slightly curved medially, with 6 preapical setae. Superior volsella (Fig. 24B) length 62; width 40; LWR 1.6; pediform, with 5 sensilla chaetica. Inferior volsella length 130; deeply bifid, with 4 sensilla chaetica each on proximal and distal lobes, with 1–2 well developed ventral preapical setae. Anal point bare dorsally; with basal peduncle and bulbous ventral extension; with 2 dorsal basal setae and 6–9 lateral basal setae.

Dicrotendipes radinovskyi sp. nov. (Fig. 25)

TYPE LOCALITY: Brazil, Amazonas, lower Rio Preto da Eva.

TYPE MATERIAL: **Holotype:** male, BRAZIL: Amazonas: lower Rio Preto da Eva, left tributary of upper Rio Amazonas, village Tiririca, light trap, [no date], leg. E.J. Fittkau (ZS). **Paratypes** (2): same data as holotype, 2 males (ZS). Holotype to be deposited in IN, paratypes in ZS.

DIAGNOSIS: The immaculate wings, deeply bifid inferior volsella, distinctive bifid superior volsella and bulbous swelling beneath the anal point will distinguish this species.

ETYMOLOGY. I take great pleasure in naming this species for my undergraduate mentor, Dr. Syd Radinovsky.

MALE IMAGO (n = 3)

COLOR (slide mounted specimens). Head, body and legs light brown. Wing immaculate, dusky brown, with brown veins.

LENGTH. Total 2.91–3.28, 3.07 mm. Thorax 0.73–0.80, 0.76 mm. Abdomen 2.18–2.48, 2.31 mm.

HEAD. Setae: temporal 29–34, 31; clypeal 12–14, 13; cibarial 6 (1). Palpomere lengths: 32–35, 33; 38–47, 43; 74–98, 89; 98–123, 114; 155–183, 168. Frontal tubercles 8–13, 11 long, 7–8, 8 wide. AR 1.85–1.92, 1.88.

THORAX. Scutal tubercle well developed; humeral pit with 6 medium tubercles. Acrostichals 6–7 (2); dorsocentrals 12–18, 15; scutellars 7–9, 8; prealars 8.

WING. Length 1.48–1.58, 1.52 mm; width 0.41–0.44, 0.43 mm. FCu distal to RM. VR 0.86–0.89, 0.88. Setae: brachiolum 2; squama 0(?)–4, 2; R 13–18, 15; R_1 4–8, 6; R_{4+5} 10–13, 12.

LEGS. Foretarsal beard absent. Palmate sensilla chaetica: 7–13, 9 on middle metatarsus, 3–4, 4 on hind metatarsus. Lengths and proportions of legs, p. 77.

ABDOMEN. 4–6 ventral accessory setae on S VI.

HYPOPYGIUM (Fig. 25A) with 2–3 medial setae. Gonostylus apically expanded, slightly curved medially, with 6 preapical setae. Superior volsella (Figs. 25B, C, D) bifid; length of dorsal portion 43–55, 51, ventral portion 53–80, 66; width of dorsal portion 15–21, 18, ventral portion 29–43, 36; dorsal portion digitiform with 2 sensilla chaetica, ventral portion expanded, with 3 sensilla chaetica. Inferior volsella length 138–151, 143; deeply bifid, with 4–5 sensilla chaetica on proximal lobe, 5–6 sensilla chaetica on distal lobe, with 2 well developed ventral preapical setae. Anal point bare dorsally; with triangular basal peduncle and bulbous ventral extension; deflexed; with 1–2 dorsal basal setae and 8–11 lateral basal setae.

Dicrotendipes reissi sp. nov. (Fig. 26)

TYPE LOCALITY: Paraná Madeirinha, lower Rio Madeira, Amazonas, Brazil.

TYPE MATERIAL: **Holotype:** male, BRAZIL: Amazonas, lower Rio Madeira, Paraná Madeirinha, light trap, 12-IX-1960, leg. E.J. Fittkau (ZS). **Paratypes** (212): same data as holotype, 202 males (ZS); Amazonas: Ilha do Careiro, upper Rio Amazonas, nr Manaus, Paraná

	P_1	P_2	P_3
fe	810–900, 847	690–750, 717	770–865, 808
ti	480–530, 500	600–675, 637	780–880, 822
ta_1	1110 (1)	340–390, 360	490–560, 522
ta_2	510 (1)	160–185, 168	245–280, 258
ta_3	440 (1)	105–110, 108	185–215, 197
ta_4	385 (1)	40–50, 47	85–105, 93
ta_5	185 (1)	50–55, 53	70–85, 78
LR	2.31 (1)	0.55–0.58, 0.57	0.61–0.66, 0.64
BV	1.58 (1)	4.52–4.59, 4.55	3.36–3.50, 3.44
SV	1.16 (1)	3.65–3.84, 3.76	3.01–3.26, 3.13

da Terra Nova at Careiro, ca. 2 km from mouth, light trap, 15-III-1961, leg. E.J. Fittkau, 1 male (ZS); lower Rio Preta da Eva, left tributary of upper Rio Amazonas, village Tiririca, light trap, [no date], leg. E.J. Fittkau, 7 males (ZS). Pará: Rio Cururú, Missão Cururú, right tributary of Rio Tapajós, 12-I-1961, leg. E.J. Fittkau, 1 male (ZS); same locality & collector, [no date], 1 male (ZS). Holotype to be deposited in IN; paratypes in ZS, JE.

DIAGNOSIS: The immaculate wings, deeply bifid inferior volsella, distinctive superior volsella, clavate gonostylus and weakly cordiform-emarginate base of the anal point will distinguish this species. The female and immature stages are unknown.

ETYMOLOGY. I take great pleasure in naming this species in honor of Dr. F. Reiss, who has been so kind and helpful to me throughout my studies of the Chironomidae.

MALE IMAGO (n = 7)

COLOR (slide mounted specimens). Head, body and legs light brown. Wing immaculate, slightly dusky brown, with yellow-brown veins.

LENGTH. Total 2.93–3.28, 3.07 mm. Thorax 0.71–0.84, 0.77 mm. Abdomen 2.15–2.55, 2.39 mm.

HEAD. Setae: temporal 32–39, 36 (3); clypeal 11–14, 12; cibarial 7–10, 8 (5). Palpomere lengths: 27–38, 32 (6); 35–45, 38 (6); 80–101, 88 (6); 89–123, 107 (6); 150–203, 180 (5). Frontal tubercles 8–13, 11 long, 5–8, 6 wide. AR 1.72–2.00, 1.85.

THORAX. Scutal tubercle well developed; humeral pit with 3 moderate tubercles. Acrostichals 7–8, 8 (6); dorsocentrals 14–20, 17 (6); scutellars 7–9, 8 (6); prealars 8–10, 9 (6).

WING. Length 1.31–1.50, 1.41 mm; width 0.38–0.46, 0.41 mm. FCu distal to RM. VR 0.84–0.88, 0.86. Setae: brachiolum 2; squama 1–3, 2 (5); R 13–16, 14; R_1 4–7, 6; R_{4+5} 8–12, 10.

LEGS. Foretarsal beard absent. Palmate sensilla chaetica: 6–11, 9 on middle metatarsus, 3–6, 5 on hind metatarsus. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	670–840, 776	580–690, 649	645–785, 729
ti	430–520, 489	495–615, 564	635–810, 741
ta_1	885–1105, 1009 (5)	300–370, 344	440–520, 483
ta_2	420–520, 473 (5)	145–180, 344	210–265, 239
ta_3	365–460, 412 (5)	100–135, 114	170–205, 189
ta_4	300–395, 350 (5)	40–60, 49 (6)	75–110, 89
ta_5	145–180, 159 (5)	45–55, 53 (6)	60–75, 67
LR	1.98–2.13, 2.06 (5)	0.59–0.63, 0.61	0.64–0.69, 0.65
BV	1.57–1.70, 1.63 (5)	3.90–4.32, 4.11 (6)	3.21–3.51, 3.35
SV	1.20–1.30, 1.25 (6)	3.44–3.68, 3.53	2.91–3.10, 3.04

ABDOMEN. 1–7 ventral accessory setae on S VI.

HYPOPYGIUM (Figs. 26A, B) with 14–30, 21 dorsomedial setae. Gonostylus apically expanded, curved medially, with 3–4, 3 preapical setae. Superior volsella (Figs. 26C, D) length 45–49, 47 (5); width 40–43, 41 (5); LWR 1.1–1.2, 1.1 (5); semi-pediform-triangular viewed dorsally, with ventral subapical extension; with dorsal and ventral fine setae; with 1–2 small sensilla chaetica. Inferior volsella length 118–135, 127 (5); deeply bifid, with 4–5 sensilla chaetica in single row on proximal lobe, 5–7 sensilla chaetica in single row on distal lobe; distal lobe with 1 well developed ventral preapical seta. Anal point weakly cordiform-emarginate basally, bare dorsally, with basal peduncle which slopes down from T IX; with 6–10, 8 lateral basal setae.

Dicrotendipes soccus sp. nov. (Fig. 27)

TYPE LOCALITY: Igarapé Paracaixi, left tributary of lower Rio Negro, some hours downstream from mouth of Rio Branco, Amazonas, Brazil.

TYPE MATERIAL: **Holotype:** male/Pex, BRAZIL: Amazonas: Igarapé Paracaixi, left tributary of lower Rio Negro, some hours downstream from mouth of Rio Branco, light trap, 14-II-1962, leg. E.J. Fittkau. **Paratype**s (42): Amazonas: lower Rio Madeira, Paraná Madeirinha, light trap, 11-IX-1960, leg. E.J. Fittkau, 31 males (ZS); same locality & collector, 12-IX-1960, 2 males (ZS); mouth of Rio Negro at Manaus, light trap, 17-III-1961, leg. E.J. Fittkau, 4 males (ZS); Upper Rio Solimões, Igarapé Amataura, ca. 50 km W mouth of Rio Ica, ca. 15 km from

mouth of Igarapé Amataura, light trap, 27-VIII-1961, leg. E.J. Fittkau, 1 male (ZS); Ilha do Careiro, upper Rio Amazonas, nr Manaus, Paraná da Terra Nova at Careiro, ca. 2 km from mouth, light trap, 15-III-1961, leg. E.J. Fittkau, 1 male (ZS); lower Rio Negro, Ponta Negra nr Manaus, light trap, 6-VI-1962, leg. E.J. Fittkau, 1 male (ZS); Rio Negro at Moura, light trap, 5-II-1962, leg. E.J. Fittkau, 1 male (ZS); Lago Cabaliana, lower Rio Solimões, drift, 16-VI-1971, leg. F. Reiss, 1 male (ZS). Holotype to be deposited in IN; paratypes in ZS, JE.

DIAGNOSIS: The immaculate wings, deeply bifid inferior volsella with greatly enlarged ventral subapical sensilla chaetica, distinctive slipper shaped superior volsella, clavate gonostylus and strongly cordiform-emarginate base of the anal point will distinguish this species. The female and larva are unknown.

ETYMOLOGY. From the Latin *soccus,* slipper; refers to the slipper shaped superior volsella.

MALE IMAGO (n = 7)

COLOR (slide mounted specimens). Head, body and legs light brown. Wing immaculate, light dusky brown, with yellow-brown veins.

LENGTH. Total 2.91–3.71, 3.28 (6) mm. Thorax 0.79–0.93, 0.84 (6) mm. Abdomen 2.11–2.80, 2.45 (6) mm.

HEAD. Setae: temporal 28–40, 35 (4); clypeal 9–14, 12 (6); cibarial 5–8, 7 (4). Palpomere lengths: 30–40, 34; 35–45, 41; 83–100, 90; 104–123, 113; 153–190, 179. Frontal tubercles 10 long, 5–7, 6 wide. AR 1.88–2.08, 1.99 (6).

THORAX. Scutal tubercle well developed; humeral pit with 3–5 weak to moderate tubercles. Acrostichals 7–10, 8; dorsocentrals 14–17, 16; scutellars 8–9, 9 (6); prealars 8–10, 8.

WING. Length 1.34–1.63, 1.46 mm; width 0.39–0.44, 0.42 mm. FCu distal to RM. VR 0.84–0.89, 0.86. Setae: brachiolum 2; squama 1–3, 2 (6); R 11–16, 14; R_1 2–7, 5; R_4+_5 3–15, 10.

LEGS. Foretarsal beard absent. Palmate sensilla chaetica: 6–10, 8 on middle metatarsus, 3–5, 4 on hind metatarsus. Lengths and proportions of legs, p. 80.

ABDOMEN. 2–7, 5 ventral accessory setae on S VI.

HYPOPYGIUM (Figs. 27A, B) with 22–41, 30 dorsomedial setae. Gonostylus thin, slightly curved medially, with 2–3, 3 preapical setae. Superior volsella (Fig. 27C) length 50–65, 60; width 20–25, 22; LWR 2.3–3.1, 2.7; slipper shaped, with 2 preapical sensilla chaetica. Inferior volsella length 153–165, 155 (6); deeply bifid, with 3–6 sensilla chaetica in single row on proximal lobe, 4–6 sensilla chaetica in single row on distal lobe; distal lobe with 3–8 greatly developed ventral preapical setae; at least 3 of these setae usually larger than dorsal sensilla chaetica of same lobe. Anal point strongly cordiform-emarginate basally, bare dorsally, with basal peduncle which slopes down steeply from a squat T IX; with 4–8, 6 lateral basal setae.

PUPA (n = 1)

COLOR. Clear with pale yellow-brown margins.

LENGTH. Total 4.00 mm. Cephalothorax 0.95 mm. Abdomen 3.05 mm.

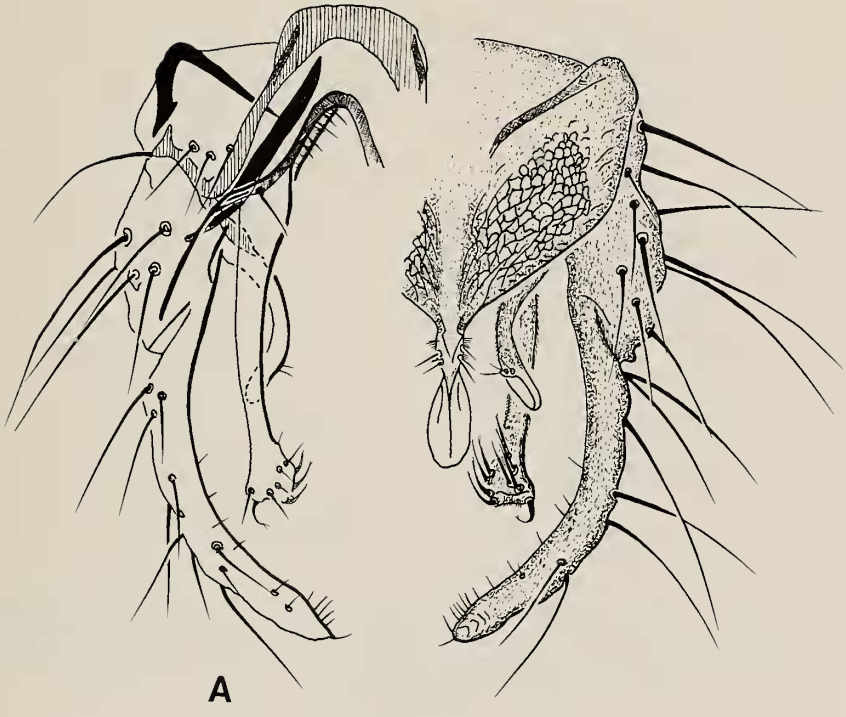
CEPHALOTHORAX. Cephalic tubercles similar to *D. fittkaui* (Fig. 20A), moderately developed. Dorsum moderately smoothly pebbled. Dc_2 closer to Dc_3. Thoracic horn base with tracheal bundles separate.

ABDOMEN. Similar to *D. fittkaui* (Fig. 21C). Sternites I-II with fine lateral shagreen bands, S I also with fine posterior shagreen; S III with scattered fine spinules; S VI with anterior and posterior areas of fine shagreen. Tergite I bare; T II with T-shaped shagreen area, spinules largest posteriorly; T III-V with median quadrilateral shagreen area; T VI with broadly tri-

	P_1	P_2	P_3
fe	725–895, 799	620–740, 671	715–840, 761 (6)
ti	470–585, 516	540–665, 599	740–870, 791 (6)
ta_1	960–1140, 1053 (6)	320–390, 352	440–540, 493 (6)
ta_2	450–530, 494 (6)	150–190, 170	220–270, 249 (6)
ta_3	385–470, 428 (6)	110–135, 121	180–210, 193 (6)
ta_4	340–410, 373 (6)	40–55, 49	80–100, 91 (6)
ta_5	150–180, 166 (6)	45–60, 53	70–80, 73 (6)
LR	2.04–2.18, 2.09 (6)	0.56–0.63, 0.59	0.59–0.67, 0.62 (6)
BV	1.53–1.63, 1.60 (6)	4.03–4.32, 4.15	3.32–3.43, 3.37 (6)
SV	1.18–1.26, 1.22 (6)	3.41–3.77, 3.61	2.93–3.31, 3.16 (6)

angular shagreen area, spinules largest mesally; T VII with an anterior pair of small ovoid shagreen areas; T VIII with a pair of longitudinal fine shagreen bands. Tergites IV and V with a posterior band of fine spinules; T V-VII with posterolateral group of fine spines. Posterior margin of T II with transverse row of 65 hooklets. T VIII with 4 lateral lamellar setae. Caudolateral spurs on T VIII similar to *D. fittkaui* (Figs. 21D, E) single or double, moderately large. Anal lobes with 38–39 setae. DR 2.08.

FIG. 13. *D. aethiops,* adult male. A) Hypopygium, dorsal/ventral. B–D) Variations of superior volsella, ventral.


A

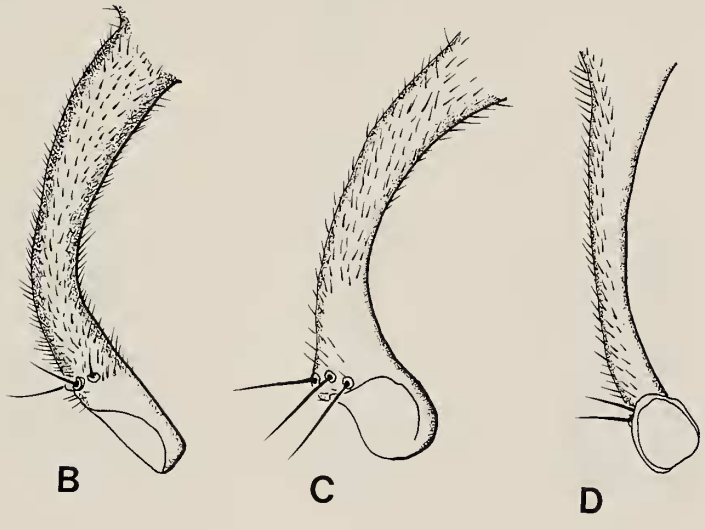
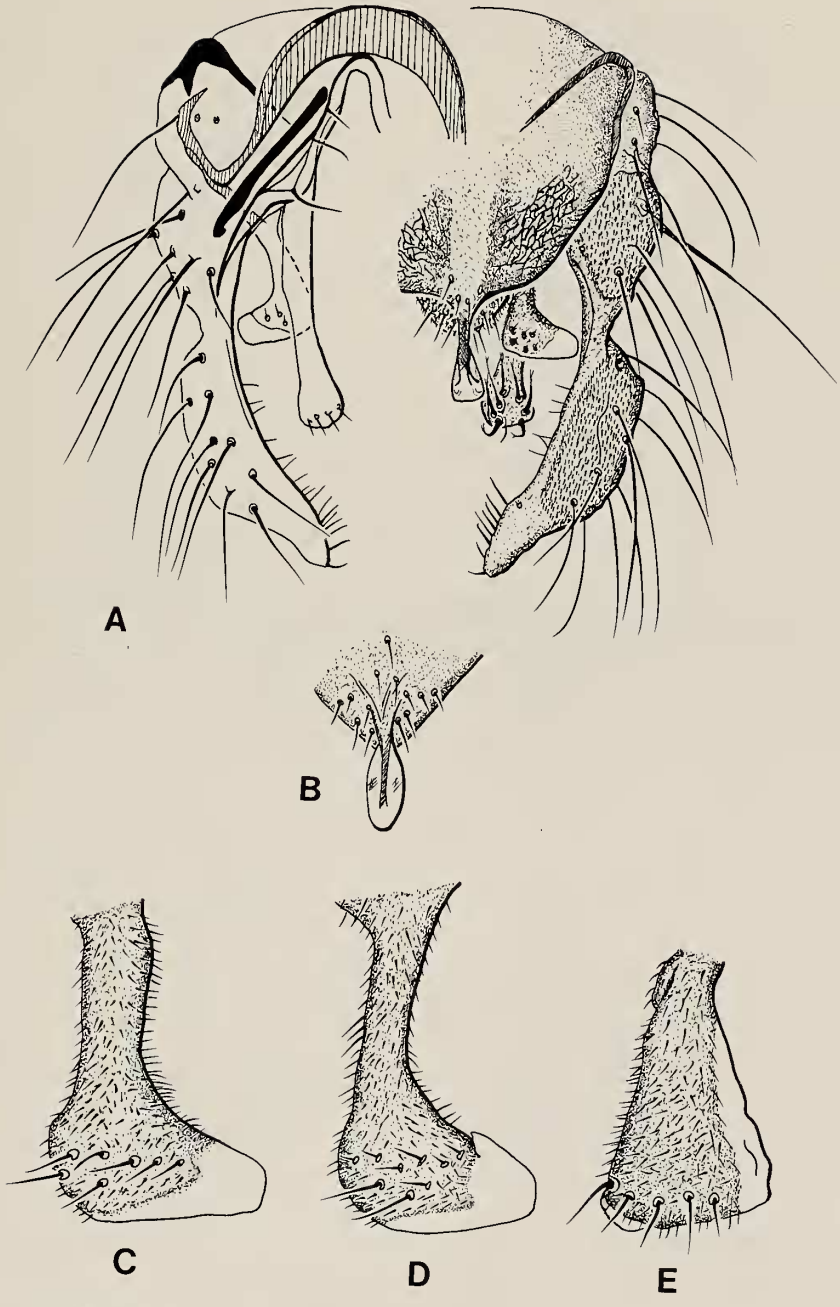

B
C
D

FIG. 14. *D. californicus,* adult male. A) Hypopygium, dorsal/ventral. B) Variation of anal point. C–D) Variations of superior volsella, ventral. E) Deformed superior volsella, ventral (Utah, U.S.A.).


A
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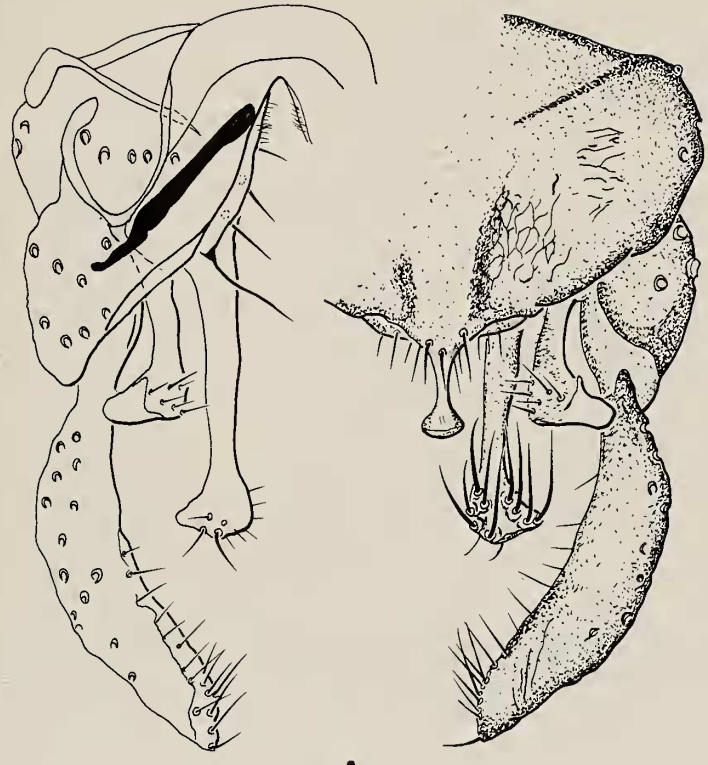
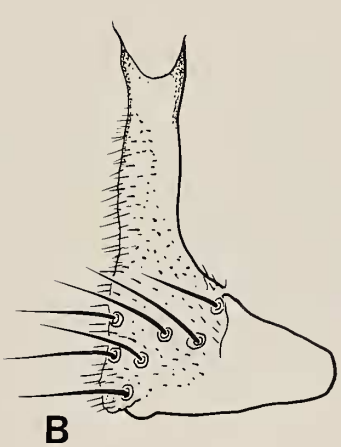
D
E

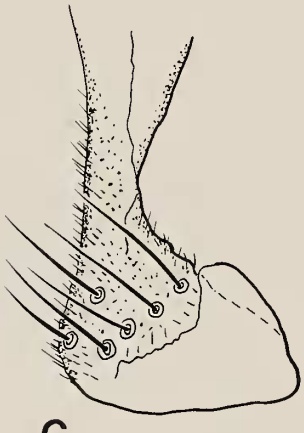
FIG. 15. *D. obrienorum,* adult male. A) Hypopygium, dorsal/ventral. B–C) Variations of superior volsella, ventral.



A

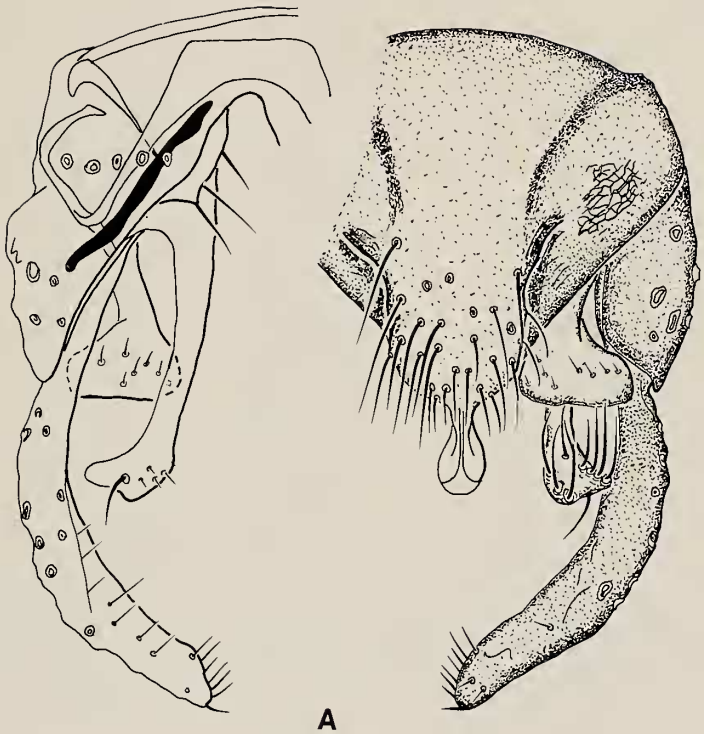


B



C

FIG. 16. *D. sinoposus,* adult male. A) Hypopygium, dorsal/ventral. B) Superior volsella, ventral.



A

B

FIG. 17. *D. amazonicus,* adult male and female. A) Hypopygium, dorsal/ventral. B) Hypopygium, lateral. C) Superior volsella, lateral. D) Superior volsella, dorsal. E) Female DmL, ApL, VlL.

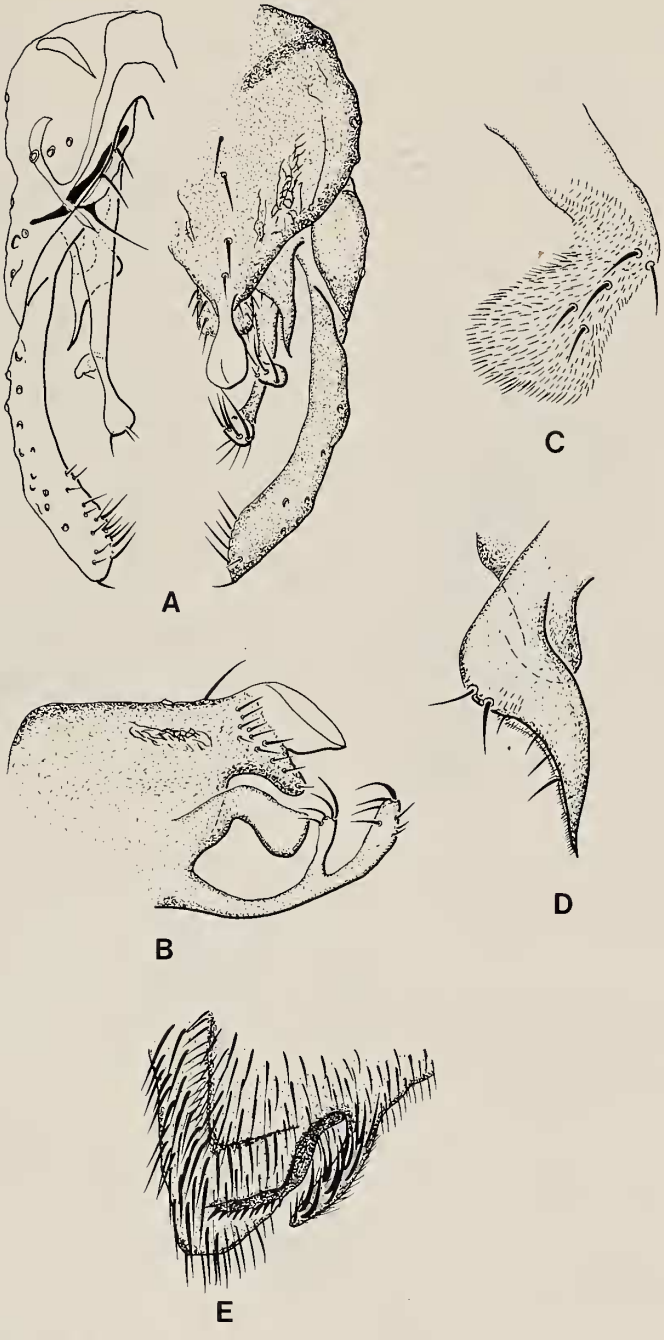

A
B
C
D
E

FIG. 18. *D. dasylabidus,* adult male. A) Hypopygium, dorsal/ventral. B) Superior volsella, dorsal.

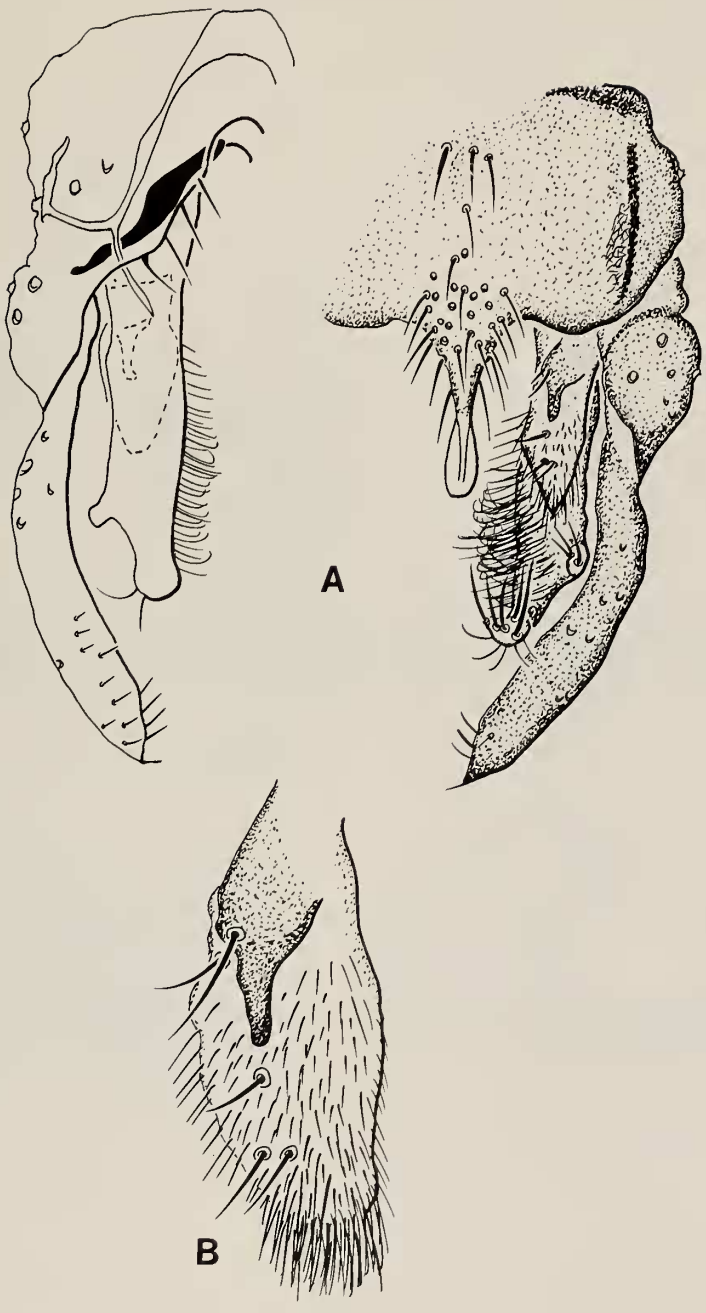

A
B

FIG. 19. *D. demissus,* adult male and female. A) Hypopygium, dorsal/ventral. B) Hypopygium, lateral. C) Superior volsella, dorsal. D) Female DmL, ApL, VlL.

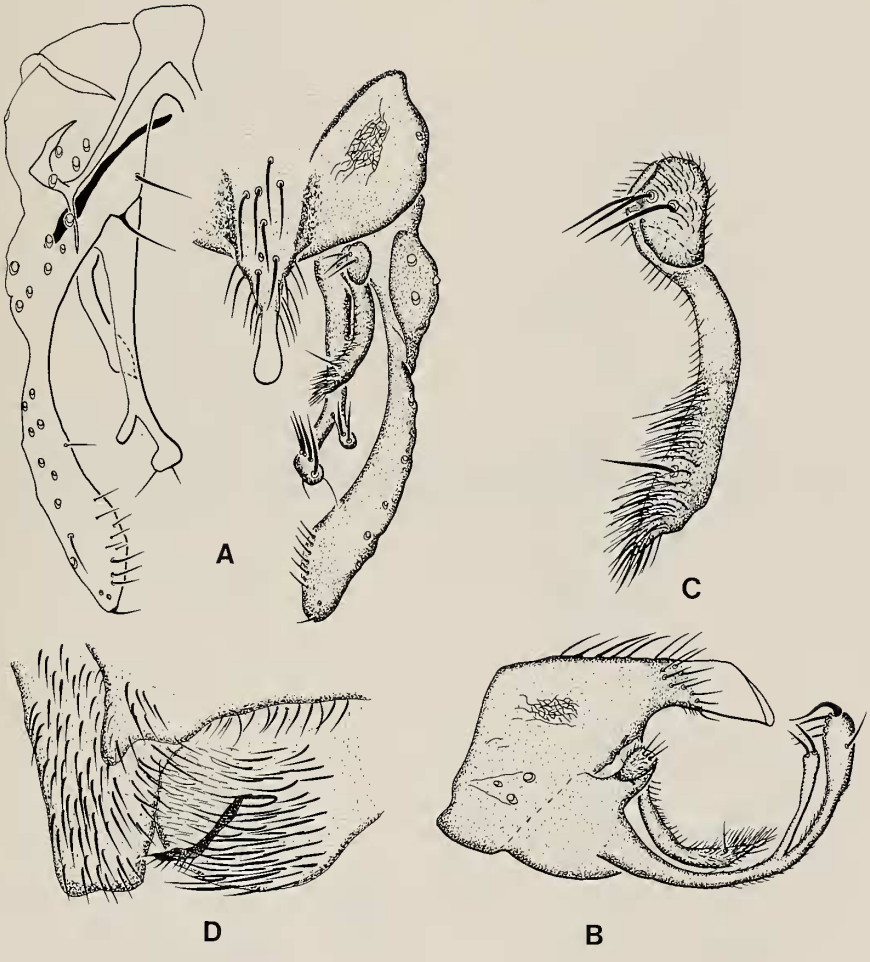

A
C
D
B

FIG. 20. *D. fittkaui,* adult male. A) Hypopygium, dorsal/ventral. B) Hypopygium, lateral. C) Superior volsella, ventral.

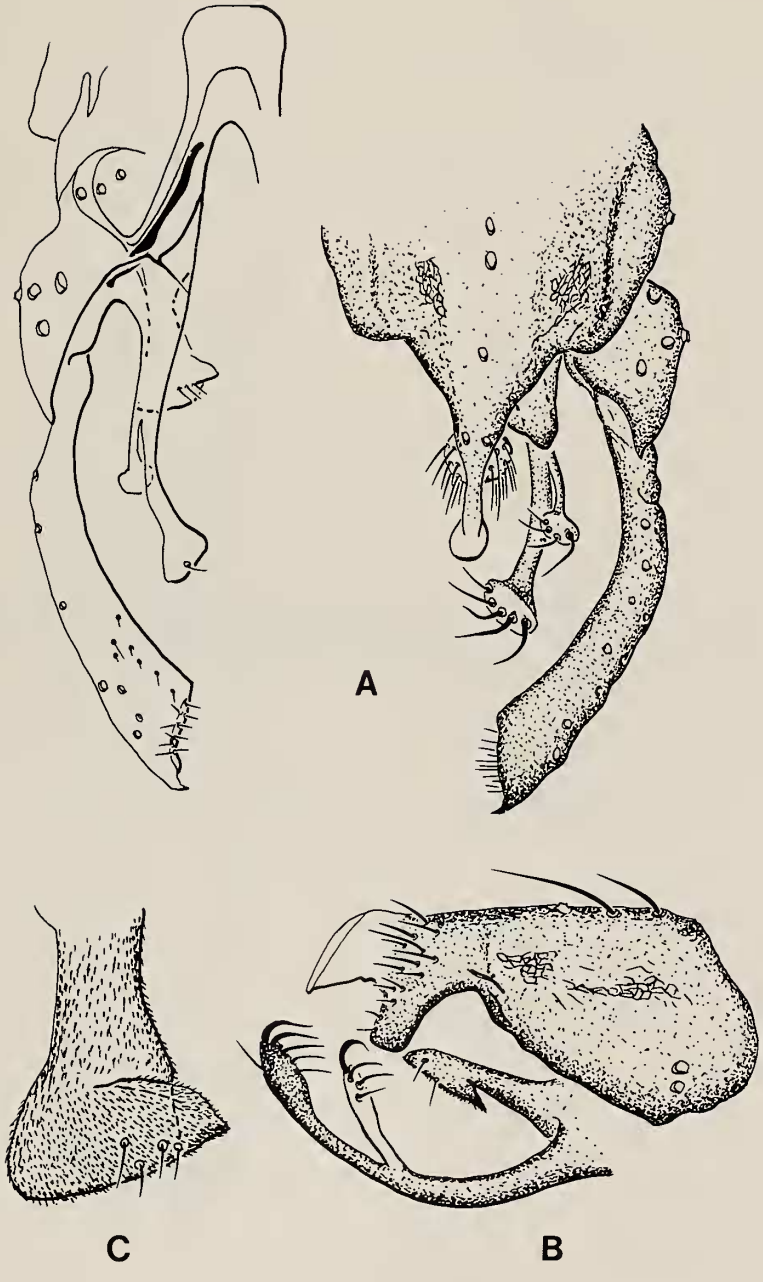

A
C
B

FIG. 21. *D.fittkaui,* pupa. A) Cephalic tubercles. B) Thoracic horn base. C) Abdomen, dorsal. D, E) Caudolateral spurs on T VIII.

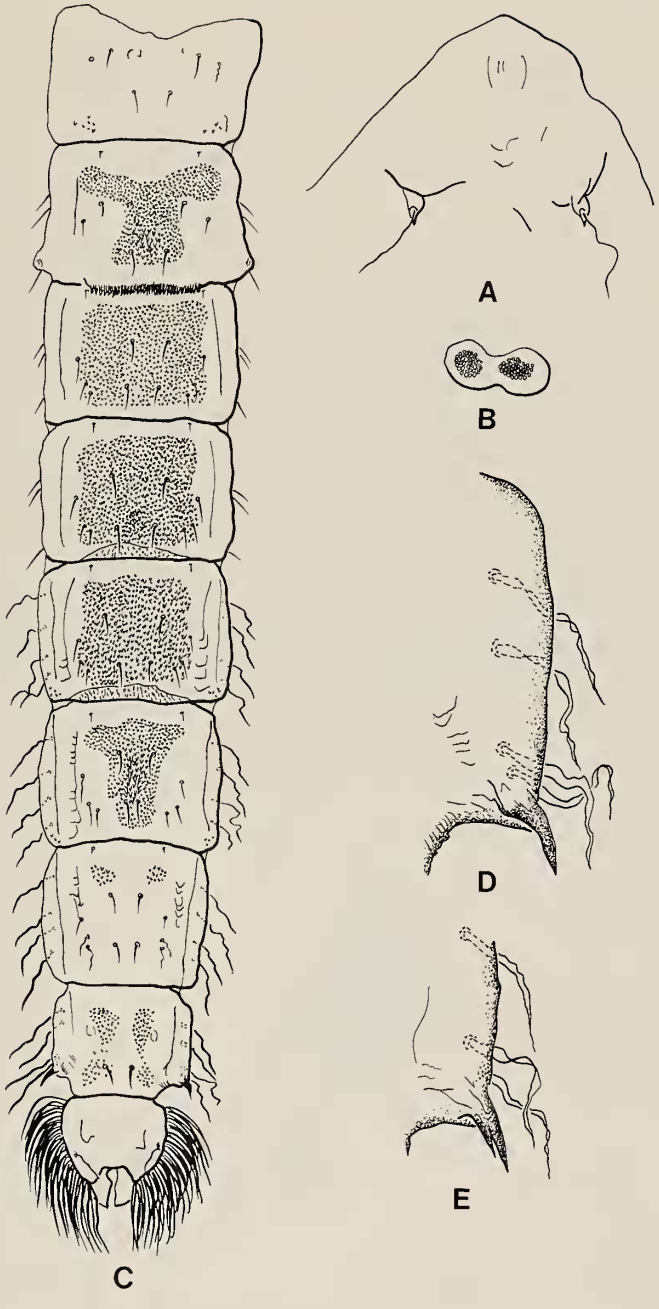
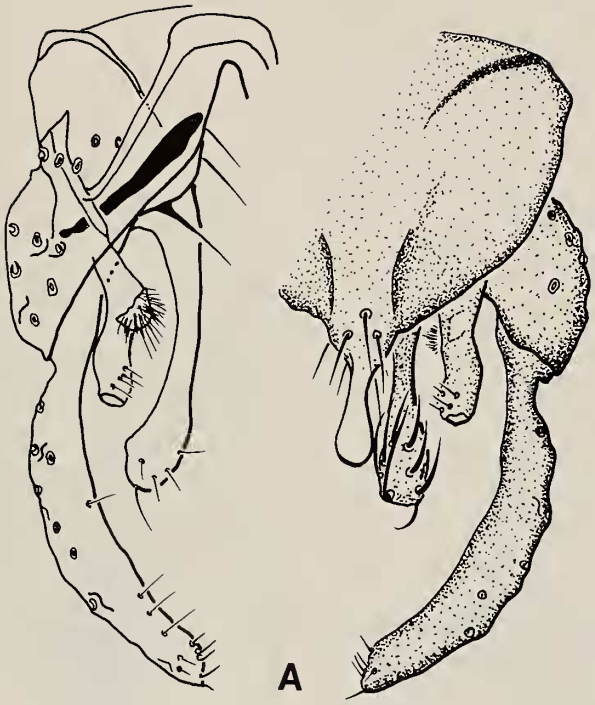

A
B
C
D
E

FIG. 22. *D. palearivillosus,* adult male. A) Hypopygium, dorsal/ventral. B) Superior volsella, ventral.


A


B

FIG. 23. *D. paradasylabidus,* adult male. A) Hypopygium, dorsal. B) Superior volsella, dorsal.

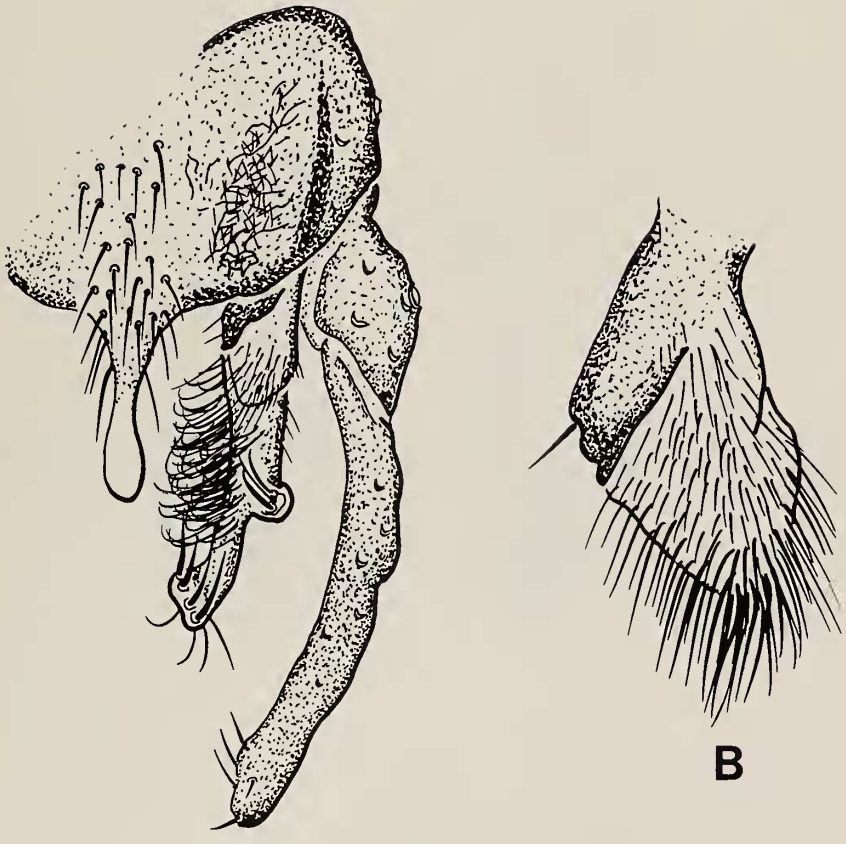
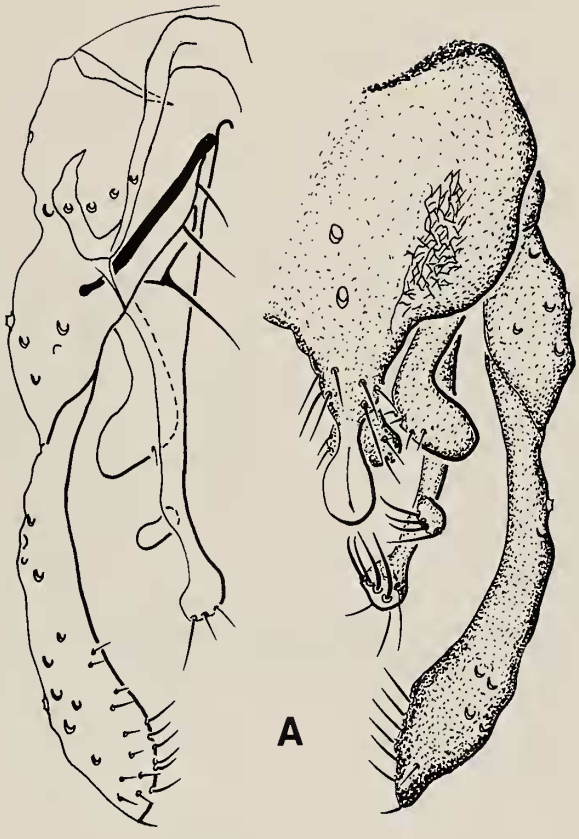

A
B

FIG. 24. *D. paterjohni,* adult male. A) Hypopygium, dorsal/ventral. B) Superior volsella, ventral.



A

B

FIG. 25. *D. radinovskyi,* adult male. A) Hypopygium, dorsal. B, C) Superior volsella, dorsal. D) Superior volsella, lateral.

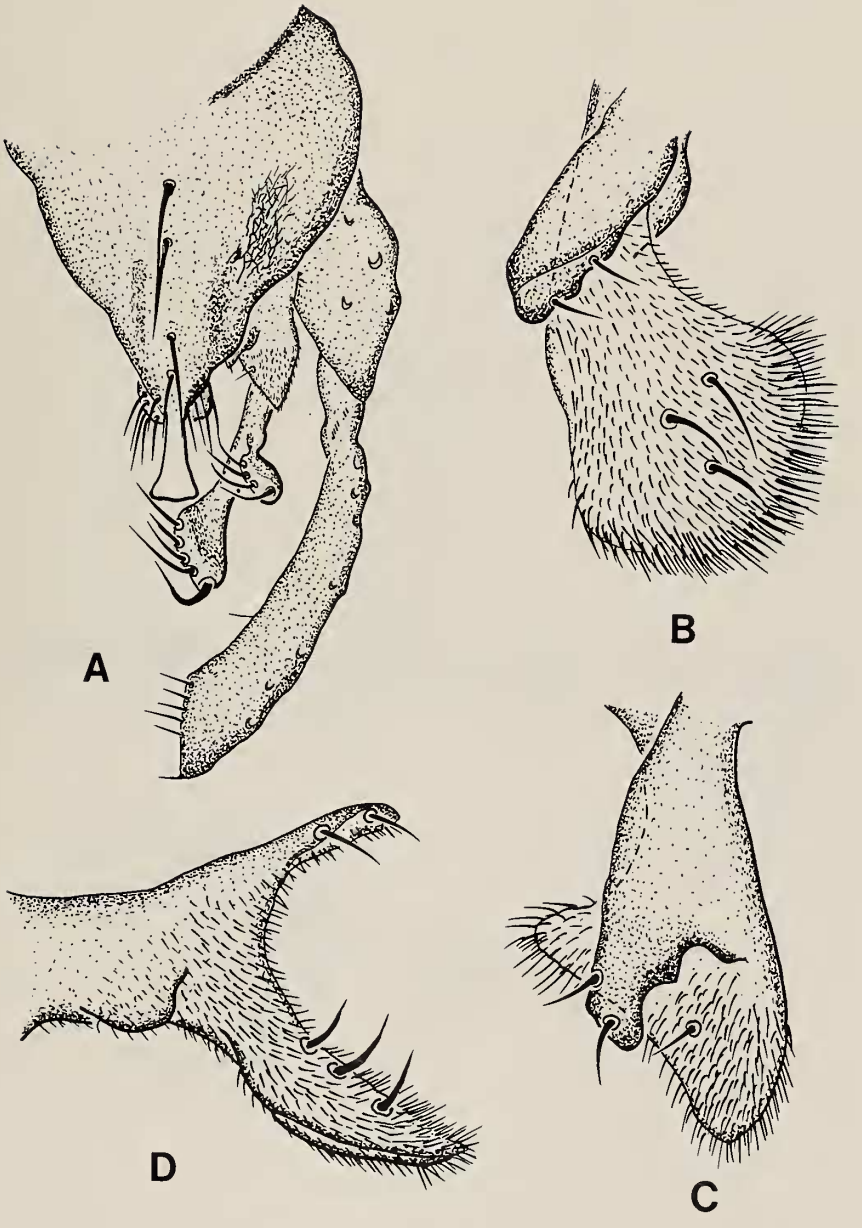

A
B
C
D

FIG. 26. *D. reissi,* adult male. A) Hypopygium, dorsal/ventral. B) Hypopygium, lateral. C) Superior volsella, dorsal. D) Superior volsella, lateral.

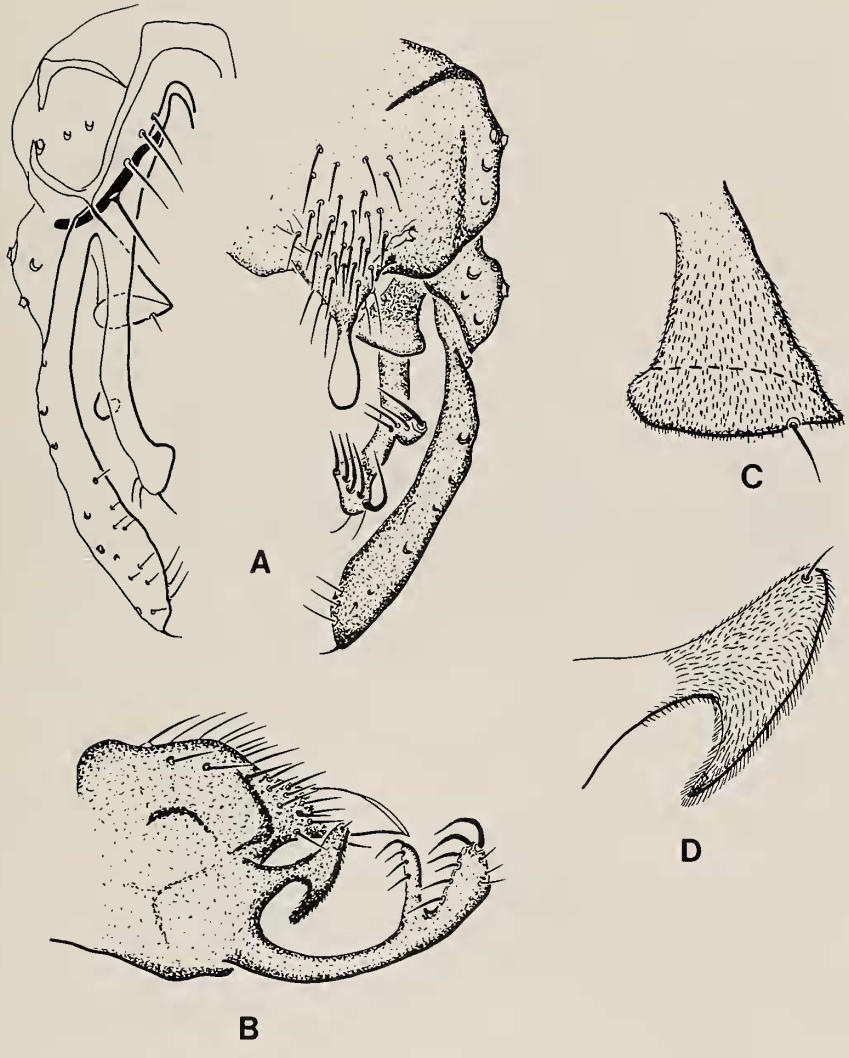
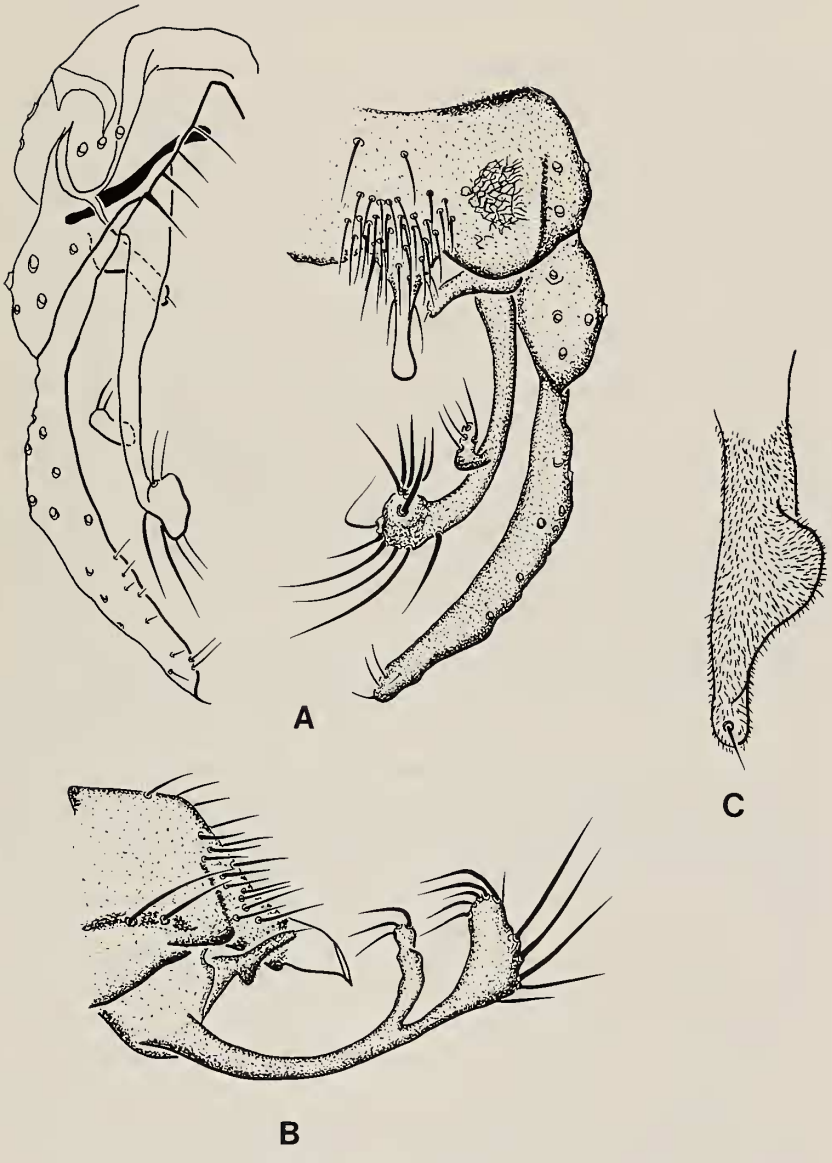

A
B
C
D

FIG. 27. *D. soccus,* adult male. A) Hypopygium, dorsal/ventral. B) Hypopygium, lateral. C) Superior volsella, dorsal.


A
B
C

Chapter IV
The *Dicrotendipes* of the Oriental-Australasian Region

The first species of *Dicrotendipes* described from the regions was named *Chironomus conjunctus* Walker (Walker 1856); Skuse (1889) merely repeated Walker's description. Kieffer also described several species from the regions in several papers (Kieffer 1910; 1911a; 1913a; 1916; 1917; 1921b). Edwards (1924; 1928) described 2 new species from Fiji and Samoa. Freeman (1961a) provided the first revision for the genus (as a subgenus of *Chironomus*) from the regions, describing 6 species from Australia, 4 of them new.

Chironomus (*Dicrotendipes*) *canterburyensis* Freeman was described from New Zealand from female specimens (Freeman 1959:425). Forsyth & McCallum (1978) reared this species (as an inquiline commensal) from a lammelibranch mussel, *Hydridella menziesi* (Gray), and on the basis of the immature stages, placed the species in *Xenochironomus* Kieffer. The genus *Dicrotendipes* remains unknown to me from New Zealand.

Sasa and Hasegawa (1983) provisionally described a species, *Dicrotendipes* sp. "Yaeyama," from Ishigaki Island in the Ryukyu Islands. The species appears to be related to the Holarctic *D. nervosus* group, not to *D. lobiger* as the authors stated. Specimens were not made available to me and it is not included in this study.

Two additional species of *Dicrotendipes* have been described from the region, *D. arcistylus* and *D. canitibialis* (Guha et al. 1985). These species are not included because they are insufficiently described and specimens were not made available. *Dicrotendipes arcistylus* may be a synonym of *D. flexus* or *D. tamaviridis* Sasa. *Dicrotendipes canitibialis* is variously spelled as *canitiibalis* and *canitibiatis* in Figure 5 and the text, respectively. Mention is made of 3 other species whose names are misspelled and/or misinterpreted: *D. conjunctus* (Walker) is misspelled as *conjuncts* and authorship of the species name is incorrectly attributed to Freeman; *D. incurvus* (Sublette), a Nearctic species, is apparently referred to as "*D. carllus*" (Guha et al. 1985:29); and *Chironomus* (*Prochironomus*) *punctatipennis* (a probable synonym of *D. septemmaculatus*) is misspelled as *D. punctipennis.*

In this study, I include 17 species from the combined Oriental-Oceanic-Australian regions. Three species previously considered to be *Dicrotendipes* are removed: *Ch. blandellus* Kieffer, 1906, (new name for *blandus* Skuse, 1889) is probably a *Chironomus* (see discussion under *D. conjunctus* below); *D. paxillus* Guha, Chaudhuri et Nandi, 1982, is a junior synonym of *Chironomus glauciventris* (Kieffer, 1912); and *D. socionotus* Guha, Chaudhuri

et Nandi, 1982, is probably a junior synonym of *Chironomus tainanus* (Kieffer, 1912). It should be noted that *Ch. tainanus* is also probably a senior synonym of *Nilodorum biroi* (Kieffer, 1918).

Key to Adult Males of Oriental-Australasian *Dicrotendipes*

[*D. arcistylus, D. canitibialis* and *D. semiviridis* not included]

1. Median volsella present (Figs. 28, 35) 2
   Median volsella absent 3
2. Median volsella short, squat (Fig. 28); wings immaculate . . . . *D. balciunasi* sp. nov.
   Median volsella long, thin (Fig. 35); wings marked with dark clouds and band. . . . . *D. lindae* sp. nov.
3. Inferior volsella with membranous dorsal extension (Fig. 34) 4
   Inferior volsella without membranous dorsal extension 5
4. Superior volsella pediform (Figs. 34A, B) . . . . . *D. jonmartini* sp. nov.
   Superior volsella digitiform (Figs. 34C, D) . . . . . *D. sarinae* sp. nov.
5. Anal point sharply deflexed, not visible in dorsal view (Figs. 29, 36) 6
   Anal point at most moderately deflexed, visible in dorsal view 7
6. Anal point long and narrow; inferior volsella with broad apical club; gonostylus of moderate width and dark brown in color (Fig. 29); wings immaculate . . . . . *D. bilobatus* (Kieffer)
   Anal point short and broad; inferior volsella with simple apex, not broadly clubbed; gonostylus broad and usually whitish to light brown (Fig. 36); wings sometimes with smoky highlights along major veins . . . . . *D. pelochloris* (Kieffer)
7. Wings with bands or spots 8
   Wings immaculate. 11
8. Wing with 6–7 spots; inferior volsella deeply bifid (Freeman 1961a:Fig. 20d). . . . . *D. septemmaculatus* (Becker)
   Wing with band of dark color; inferior volsella not deeply bifid (although dorsal sensilla chaetica may be widely separated in *D. leei* [Freeman 1961a:Fig. 20a]) 9
9. Superior volsella cylindrical-digitiform with weak membranous apex; Fiji and Samoa (Fig. 30) . . . . . *D. candidibasis* (Edwards)
   Superior volsella pediform or semi- pediform 10
10. Anal cell with spot; apex of superior volsella directed laterad; inferior volsella with dorsal sensilla chaetica only at or near apex (Freeman 1961a:Fig. 20b) . . . . . *D. taylori* (Freeman)
    Anal cell without spot; apex of superior volsella directed mesad; inferior volsella with widely separated rows of dorsal sensilla chaetica (Freeman 1961a:Fig. 20a). . . . . *D. leei* (Freeman)
11. Superior volsella slender, usually arched mesad; inferior volsella broad to extremely broad; medial setae originate from dorsal ovoid area on hypopygium. 12
    Superior volsella semi-pediform, weakly deltoid or long and slender, arched laterad; medial setae if present do not originate from dorsal ovoid area of hypopygium 14

12. Inferior volsella extremely broad (Fig. 32); acrostichal setae not present (setae-less pits present) . . . . . *D. cumberlandensis* sp. nov.
Inferior volsella not extremely broad (Fig. 31); acrostichal setae present 13

13. Superior volsella strongly arched mesad (Figs. 31D, E); foretarsal beard present. . . . . *D. pseudoconjunctus* sp. nov.
Superior volsella at most weakly arched mesad (Figs. 31A-C); foretarsal beard absent . . . . . *D. conjunctus* (Walker)

14. Superior volsella weakly deltoid, densely setose (Fig. 33) . . . . . *D. jobetus* sp. nov.
Superior volsella pediform-clubbed or long, slender and arched laterad, not densely setose 15

15. Superior volsella pediform-clubbed; distal portion not membranous, apex truncate (Fig. 37) . . . . . *D. tenuiforceps* (Kieffer)
Superior volsella thin, slender and arched laterad; distal portion membranous, apex not truncate (Johannsen 1932:Fig. 18; Hashimoto et al. 1981:Fig. 5D) (similar to Holarctic *D. nervosus*) . . . . . *D. flexus* (Johannsen)

Key to Known Pupae of Oriental-Australasian *Dicrotendipes*

1. T VII, VIII and anal lobe with extensive shagreen (Fig. 41B); S VIII with well-developed posterior shagreen band; cephalic tubercles minute. . . . . *D. flexus* (Johannsen)
T VII with at most an anterolateral pair of ovoid shagreen areas, T VIII with at most an anterior and posterior pair of ovoid shagreen areas or 2 longitudinal shagreen bands; anal lobe with or without shagreen; S VIII with faint shagreen; cephalic tubercles moderately to well developed 2

2. Posterior margin of T V with a row or groups of hooklets 3
Posterior margin of T V without hooklets 4

3. T V hooklets in 2 groups (Fig. 39K) . . . . . *D. conjunctus* (Walker); *D. pseudoconjunctus* sp. nov. (see text)
T V hooklets in continuous row (Fig. 42B) . . . . . *D. jonmartini* sp. nov.; *D. sarinae* sp. nov. (see text)

4. Anal lobe with dorsal shagreen . . . . . *D. septemmaculatus* (Becker)
Anal lobe without dorsal shagreen 5

5. Posterior portion of shagreen area on T IV & V with distinctive adjoining area of fine spine bands (Fig. 39G) . . . . . *D. cumberlandensis* sp. nov.
Shagreen areas on T IV & V without such areas 6

6. T VIII with 5 lateral lamellar setae; shagreen area on T III with anterior rows of larger spinules (Fig. 41J) . . . . . *D. pelochloris* (Kieffer)
T VIII with 4 lateral lamellar setae; shagreen area on T III with shagreen spinules larger in middle portion of area (Fig. 38C) . . . . . *D. candidibasis* (Edwards)

KEY TO KNOWN LARVAE OF ORIENTAL-AUSTRALASIAN *DICROTENDIPES*

1. Frontal apotome with a large anteromesal ovoid or subquadrate area (Figs. 40E, I; 41Q); frontal process absent 2
   Frontal apotome with small weak to strong frontal pit or process, or without markings (Figs. 7D, 38K, 41G, 42G). 5
2. 6th lateral tooth of mentum rounded and fused/appressed to 5th lateral tooth (Fig. 41N) . . . . . *D. pelochloris* (Kieffer)
   6th lateral tooth not rounded or fused/appressed to 5th lateral tooth 3
3. Median tooth of mentum broad (Fig. 40F); 29–37, 33 ventromental strial ridges. . . . . *D. cumberlandensis* sp. nov.
   Median tooth of mentum not broad (Figs. 40B, K); if relatively broad, then ventromental plates with about 40 strial ridges 4
4. Ventromental plate with 39–45, 42 strial ridges . . . . . *D. conjunctus* (Walker)
   Ventromental plate with about 28 strial ridges . . . . . *D. pseudoconjunctus* sp. nov.
5. Frontal apotome with long ventral frontal process (Fig. 7D) . . . . . *D. septemmaculatus* (Becker)
   Frontal apotome without frontal process; a weakly defined frontal pit may be present 6
6. Head capsule integument appears grainy at 400X; 1st and 2nd lateral teeth of mentum separate 7
   Head capsule integument not grainy at 400X; 2nd lateral teeth of mentum fused/appressed to 1st laterals 8
7. Ventromental plate with 35–40 strial ridges . . . . . *D. jonmartini* sp. nov.
   Ventromental plate with 28–30 strial ridges . . . . . *D. sarinae* sp. nov.
8. Median tooth of mentum sunken well below level of 1st lateral teeth (Fig. 38G); 38–40 ventromental strial ridges; frontal pit absent . . . . . *D. candidibasis* (Edwards)
   Median tooth at same level as 1st lateral teeth; 21–23 ventromental strial ridges; frontal apotome with weak frontal pit . . . . . *D. flexus* (Johannsen)

Dicrotendipes balciunasi sp. nov. (Fig. 28)

TYPE LOCALITY: Fogg Dam, NE of Humpty Doo, Northern Territory, Australia.

TYPE MATERIAL: **Holotype:** male, AUSTRALIA: Northern Territory: Fogg Dam, 15 km NE Humpty Doo, at UV light, 5-X-1982, leg. J.K. Balciunas & J. Gillett (JB). **Paratypes** (22): same data as holotype, 20 males (JB). Western Australia: De Grey River, 80 km NE Port Hedland, 27-28-XI-1984, leg. B. & M. Baehr, 1 male (ZS); Mary River, 115 km WSW Hall's Creek, sandy river bed with some restpools, 17-18-XI-1984, leg. B. & M. Baehr, 1 male (ZS). Holotype to be deposited in AN; paratypes in AN, BM, JE, and ZS.

DIAGNOSIS: The immaculate wings, somewhat pediform superior volsella and short, squat median volsella will distinguish this species. The female and immature stages are unknown.

ETYMOLOGY: I am happy to name this species for Dr. Joe Balciunas, who collected the majority of the type material.

MALE IMAGO (n = 5)

COLOR (slide mounted specimens). Head and body brown, with posterior portions of abdominal tergites V–VIII lighter; legs light brown, apical ¼ of femora and fore tibiae dark brown; fore metatarsus light brown at base, gradually darkening distally, tarsomeres dark brown; mid and hind tibiae light brown with dark brown apices, metatarsi light brown, tarsomere 2 light brown proximally, darker brown distally, remaining tarsomeres brown. Wing immaculate, clear; with light yellow-brown veins.

LENGTH (4). Total 3.08–3.98, 3.67 mm. Thorax 0.90–1.05, 0.97 mm. Abdomen 2.10–2.98, 2.70 mm.

HEAD. Setae: temporal 29–40, 33; clypeal 9–17, 13; cibarial 5–16, 11. Palpomere lengths: 40–57, 46; 43–54, 50; 103–135, 112; 150–183, 163; 215–273, 243. Frontal tubercles 5–14, 8 long, 5 wide (3). AR 1.87–2.19, 2.10.

THORAX. Scutal tubercle well developed; humeral pit with 2–5 small to medium tubercles or a bare spot on cuticle. Acrostichals 12–13 (2); dorsocentrals 17–27, 20; scutellars 6–12, 8; prealars 6–10, 8.

WING. Length 1.38–1.60, 1.47 mm; width 0.44–0.51, 0.47 mm. FCu slightly distal to or below RM. VR 0.83–0.95, 0.91. Setae: brachiolum 2; squama 7–11, 8; R 6–14, 10; R_1 0; R_{4+5} 2.

LEGS. Foretarsal beard absent. Palmate sensilla chaetica: 8–16, 11 on middle metatarsus, 0 on hind metatarsus. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	670–810, 721	610–750, 654	660–840, 717
ti	495–620, 535	565–700, 605	720–920, 717
ta_1	970–770 (2)	260–330, 289	470–620, 539 (4)
ta_2	355–450 (2)	150–190, 167	250–320, 275 (4)
ta_3	305–360 (2)	105–140, 120	220–275, 240 (4)
ta_4	220–280 (2)	60–90, 74	120–165, 136 (4)
ta_5	130–150 (2)	60–80, 68	80–100, 91 (4)
LR	1.56 (2)	0.45–0.50, 0.48	0.65–0.76, 0.70 (4)
BV	1.92–1.94 (2)	3.45–3.80, 3.62	2.61–2.85, 2.74 (4)
SV	1.47–1.51 (2)	4.17–4.63, 4.36	2.57–3.01, 2.77

ABDOMEN. Ventral accessory setae on S VI not apparent.

HYPOPYGIUM (Figs. 28A, B) with 0–3 medial setae. Gonostylus normal, slightly curved medially, with 4–6, 5 preapical setae. Superior volsella (Fig. 28C) length 43–65, 53; width 34–

48, 39; LWR 1.1–1.9, 1.4; pediform (somewhat triangular in deformed individuals) with 4–5 sensilla chaetica. A short, squat, membranous median volsella present dorsal to base of inferior volsella. Inferior volsella length 78–108, 89; simply clubbed, with 8–10 sensilla chaetica scattered on apex; with one well developed ventral preapical seta. Anal point bare dorsally, not deflexed; with 3–6, 4 dorsal basal setae and 6–8, 7 lateral basal setae.

REMARKS. A most unusual species for the genus; along with *D. lindae* sp. nov., *D. balciunasi* possesses a median volsella. Unfortunately, the immature stages of both species are unknown. I see no reason for establishing a new genus for this species and *lindae;* however, this may be necessary once the immature stages are found.

Dicrotendipes bilobatus Kieffer (Fig. 29)

Dicrotendipes bilobatus Kieffer, 1917:222.
nec *Chironomus* (*Dicrotendipes*) *conjunctus* Walker 1856: Freeman 1961a:695.

DIAGNOSIS: The immaculate wings, digitiform superior volsella and sharply deflexed anal point, which is not visible from a dorsal view, will distinguish this species. The female and immature stages are unknown.

MALE IMAGO (n = 3)

COLOR (pinned specimens). Head light brown, antennae darker; thorax light yellow-brown with red-brown vittae, scutellum light yellow-brown, postnotum dark red-brown; abdomen dark red-brown, distally lighter on T III-IV; fore femur stramineous, apex brown, remainder of leg brown, mid and hind legs stramineous, apex of tibiae brown, metatarsi stramineous with apices brown, remainder of legs brown. Wings immaculate, light dusky brown; veins light yellow-brown.

LENGTH. Total 4.52–4.76, 4.63 mm. Thorax 1.14–1.23, 1.19 mm. Abdomen 3.38–3.56, 3.45 mm.

HEAD. Setae: temporal 30–41, 34; clypeal 14–17, 16; cibarial 14–15, 14. Palpomere lengths (2): 52–62; 65–70; 175–182; 205; 290–295. Frontal tubercles 23–30, 26 long, 10–12, 11 wide. AR 2.38–2.51, 2.46.

THORAX. Scutal tubercle well developed; humeral pit with 3 large tubercles. Acrostichals 10–14, 12; dorsocentrals 15–19, 17; scutellars 9–13, 11; prealars 8–10, 9.

WING. Length 2.58–2.69, 2.62 mm; width 0.66–0.67, 0.67 mm. FCu slightly distal to or below RM. VR 0.90–0.97, 0.92. Setae: brachiolum 2; squama 6–11, 9; R 19–25, 22; R_1 12–19, 16; R_4+_5 24–33, 29.

LEGS. Foretarsal beard apparently absent. Palmate sensilla chaetica: 9–16, 12 on middle metatarsus, 0 on hind metatarsus. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	1230–1240, 1237	1075–1110, 1090	1155–1190, 1172
ti	780–800, 793	990–1000, 993	1310–1320, 1313
ta_1	1560–1660, 1617	560–590, 573	855–905, 873
ta_2	765–820 800	295–300, 298	430–465, 452
ta_3	610–660, 640	210–215, 212	350–355, 352
ta_4	475–510, 498	110–120, 117	180–190, 183
ta_5	200	90	110–115, 112
LR	2.00–2.08, 2.02	0.56–0.60, 0.58	0.65–0.69, 0.67
BV	1.68–1.75, 1.71	3.66–3.73, 3.71	3.01–3.15, 3.06
SV	1.23–1.29, 1.26	3.50–3.77, 3.64	2.74–2.92, 2.85

ABDOMEN. Ventral accessory setae on S VI not apparent.

HYPOPYGIUM (Figs. 29A, B) with 7–9, 8 medial setae. Gonostylus moderately wide, curved medially, with 5–6, 5 preapical setae. Superior volsella (Fig. 29C) length 80–95 (2); width 30–33 (2); LWR 2.7–2.9; digitiform with slightly expanded apex, with 6–8, 7 sensilla chaetica. Inferior volsella length 168–183 (2); with shallow apical notch, with 8–11 sensilla chaetica in 2–3 rows of 2–5 each; one well developed ventral preapical seta. Anal point narrow, bare dorsally, completely deflexed beneath T IX; with 0 dorsal basal setae and 9–10, 10 lateral basal setae.

REMARKS. Freeman (1961a) synonymized this species with *conjunctus* Walker on the basis of hypopygial similarities. Freeman apparently relied on Kieffer's figure (Kieffer 1917:Fig. 15) to do so. The hypopygium of *bilobatus* is unusual in that the anal point is strongly bent beneath T IX (Fig. 29); Kieffer's hypopygium figure does not show an anal point. I have seen pinned and fluid preserved specimens in which the anal point is strongly deflexed, and I assume that Kieffer had similar specimens before him. The superior volsellae of the 2 species are basically identical; the only character separating them is the anal point. Whether the strongly deflexed anal point is an artifact of preservation, a true species difference or perhaps an indication of a post-copulating condition may be resolved by examination of reared specimens. I am returning *bilobatus* to species status because of this uncertainty, with the hopes that it might interest workers to rear this unusual *Dicrotendipes*.

The type of *bilobatus* was apparently in the Hungarian National Museum and was probably lost in the fire of 1956 (Freeman 1961a).

MATERIAL EXAMINED: AUSTRALIA: Australian Capital Territory: Canberra, pond margin, 21 Nov. 1956, leg. W.W. Wirth, 1 male (US). New South Wales: Deewhy, South Creek, 27 Sept. 1956, leg. W.W. Wirth, 6 males (US).

Dicrotendipes candidibasis (Edwards) (Figs. 30, 38)

Chironomus (*Xenochironomus?*) *candidibasis* Edwards, 1924:573.
Chironomus melanocnemis Edwards, 1928:65. **NEW SYNONYMY.**

DIAGNOSIS: The adult is recognized by the distinctive wing and leg markings, the low number of acrostichal setae and the weakly sclerotized digitiform superior volsella of the male. The pupa can be separated by the 4 lateral lamellar setae on T VIII and the distinctive shagreen pattern. The unusual larva is recognized by its distinctive mentum with the sunken median tooth and the almost completely fused first and second lateral teeth.

MALE IMAGO (n = 5)

COLOR (pinned specimens). Head and thorax fuscous-light- brown, with scutellum lighter; abdominal T I-V with greenish base color, T II-IV with median brown saddle; T V with proximal ⅓ light green-brown, distal portion brown; T VI-VIII dark brown, hypopygium brown with gonocoxites, styli and volsellae white to very light brown; legs with femora greenish stramineous, fore and hind femora with brown apices; fore and hind tibiae with proximal 1/5 white, remainder brown or tibiae completely brown, mid tibia greenish-stramineous with light brown apex; fore metatarsus with extreme proximal light brown band followed by extensive white area and brown apical band, mid tibia with basal half white with postmedian brown band and white apex, hind tibia white with brown apex; all remaining tarsomeres brown. Wing with broad median band beginning at RM and extending distally through ⅓ to ½ of cells r_{4+5}, m_{1+2} and m_{3+4}; band stops at Cu_1 or continues to lower wing margin and extends forward or slightly proximal to FCu; also with dark areas over vannal fold and An.

LENGTH. Total 3.75–3.78 (2) mm. Thorax 1.05–1.08 (2) mm. Abdomen 2.65–2.85, 2.77 mm.

HEAD. Setae: temporal 16–32, 22; clypeal 20–39, 26; cibarial 8–10, 9. Palpomere lengths: 42–52, 47; 44–52, 50; 142–183, 166; 195–228, 209; 295–360, 318. Frontal tubercles 2 long, 5 wide (2). AR 1.43–1.73, 1.55.

THORAX. Scutal tubercle moderately developed; humeral pit well developed with many small to medium tubercles or 2 large tubercles or a pit. Acrostichals 0–2, 1; dorsocentrals 10–15, 12; scutellars 4–12, 7; prealars 6.

WING. Length 1.75–1.90, 1.84 mm; width 0.49–0.53, 0.51 mm. FCu below RM. VR 0.95–0.98, 0.96. Setae: brachiolum 1–2, 2; squama 2–6, 4; R 22–33, 27; R_1 10–17, 13; R_{4+5} 3–15, 2.

LEGS. Foretarsal beard absent. Palmate sensilla chaetica: 8–16, 11 on middle metatarsus, 0 on hind metatarsus. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	1005–1170, 1057	790–950, 850	980–1180, 1051
ti	720–900, 774	660–800, 715	950–1120, 1013
ta_1	1130–1220, 1178 (4)	410–455, 439	630–690, 664
ta_2	555–610, 580 (4)	210–230, 218	330–410, 355
ta_3	460–500, 476 (4)	140	275–310, 290
ta_4	415–450, 430 (4)	55–60, 59	145–165, 151
ta_5	185–190, 188 (4)	50–60, 52	75–90, 83
LR	1.55–1.64, 1.59 (4)	0.56–0.64, 0.62	0.62–0.68, 0.66
BV	1.73–1.80, 1.76	4.00–4.63, 4.27	3.08–3.14, 3.10
SV	1.48–1.54, 1.50 (4)	3.44–3.89, 3.56	3.00–3.33, 2.51

ABDOMEN. 0–3 ventral accessory setae on S VI.

HYPOPYGIUM (Figs. 30A, B). Gonostylus normal, slightly curved medially, with 5–6 preapical setae. Superior volsella (Figs. 30C, D) length 20–43, 28; width 19–25, 24; LWR 0.8–2.3, 1.3; digitiform with membranous apex; with 4–6, 5 sensilla chaetica. Inferior volsella length 85–130, 104; notched slightly apically, with 1–5 sensilla chaetica in 1–3 rows, with 1–3 well developed ventral preapical setae. Anal point bare dorsally, not deflexed; with 1–6, 3 dorsal basal setae and 5–8, 7 lateral basal setae.

FEMALE IMAGO (n = 2)

COLOR. Similar to male. The band across the wing extends further distad in cell m_{1+2}.

LENGTH. Total 3.11 (1) mm. Thorax 1.16 (1) mm. Abdomen 1.95–2.03 mm.

HEAD. Setae: temporal 21–22; clypeal 34–36; cibarial 10–12. Palpomere lengths: 48–55, 43–50; 178–185; 210–245; 330–372. Frontal tubercles minute, not measurable. AR 0.46.

THORAX. Scutal tubercle moderately developed; humeral pit a well developed pit. Acrostichals 0–2 (3); dorsocentrals 16; scutellars 8–9; prealars 6.

WING. Length 2.08 mm; width 0.63–0.64 mm. FCu proximal to RM. VR 0.95–0.98. Setae: brachiolum 2; squama 7; R 30–36; R_1 15–16; R_{4+5} 31–33.

LEGS. Foretarsal beard absent. Palmate sensilla chaetica: 36–42 on middle metatarsus; 0 on hind metatarsus. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	1100–1105	850–870	1030–1095
ti	760–790	710–750	980–1070
ta_1	1270–1310	455–470	660–680
ta_2	590–625	200–220	310–360
ta_3	510–520	135–140	275–295
ta_4	460–490	55	130–150
ta_5	200–205	55–60	80
LR	1.66–1.67	0.63–0.64	0.64–0.67
BV	1.74–1.78	4.40–4.53	3.21–3.36
SV	1.45–1.46	3.43–3.45	3.05–3.18

ABDOMEN. Ventral accessory setae not apparent on S VI. Notum 145–168; cerci 100–120. S VIII with 25–28 setae/side; X with 4–5 setae; Gc IX with 1–2 setae/side. ApL as in Fig. 30E.

PUPA: (n = 9)

COLOR. Clear with pale yellow-brown borders.

LENGTH. Total 4.13–4.79 (2) mm. Cephalothorax 1.00–1.13, 1.06 (3) mm. Abdomen 2.83–3.68, 3.23 (7) mm.

CEPHALOTHORAX. Cephalic tubercles well developed (Fig. 38A), 25–50 (2) high, 63–108 (2) wide. Dorsum moderately to well pebbled. Dc2 closer to Dc3. Thoracic horn base (Fig. 38B) with tracheal bundles fused.

ABDOMEN (Fig. 38C). Sternite I with very fine shagreen areas, S II-IV with fine lateral shagreen bands; S VI-VII with anterior pair of oval fine shagreen areas; T II with median broadly T-shaped shagreen area; T III-IV with median quadrilateral shagreen areas, areas narrower posteriorly; T VI with roughly V-shaped shagreen area; T VII with an anterior pair of suboval shagreen areas; T VIII with a pair of longitudinal bands of fine shagreen; shagreen areas on T II-VI with spines larger in middle portion of area. Tergites IV-V with posterior band of fine spinules. Posterior margin of T II with transverse row of 64–104, 89 hooklets. T VIII with 4 lateral setae. Caudolateral spurs on T VIII (Figs. 38D, E) single or with basal spurs. Anal lobes with 29–44, 37 setae. DR 1.84–2.23, 1.99.

FOURTH INSTAR LARVA: (n = 5)

COLOR. Head capsule light brown, postmentum darker.

HEAD. Postmentum length 238–250 (2). Mandible (Fig. 38F) length 188–210, 192, with 3 triangular lateral teeth; two well developed dorsal teeth present. Pecten mandibularis composed of 7–9, 8 setae. Mentum (Fig. 38G) with 13 teeth, median tooth sunk well below level of 1st laterals; 1st and 2nd lateral teeth fused, giving appearance of notched 1st lateral tooth; width 95–109, 103 (4); MR 2.24–2.48, 2.34 (4). Ventromental plate with smooth anterior margin; width 85–92, 88; length 47–54, 49. VPR 1.70–1.90, 1.78; IPD 49–56, 52 (4); PSR 1.64–1.78, 1.72 (4); 38–40, 39 strial ridges. Length of antennal segments (3): 38–40, 39; 51–60, 55; 17–19, 18; 8–10, 9; 7–8, 7. AR 1.02–1.15, 1.09 (3) (Fig. 38H). Inner blade of premandible (Fig. 38I) subequal to outer blade. Pecten epipharyngis (Fig. 38J) with 3 lobes. Anterior margin of frontal apotome (Fig. 38K) without discernible features, labral sclerite 1 smooth. S I with 6–9 fringes (Fig. 38L).

BODY. Ventral tubuli absent.

REMARKS. A large amount of reared material from Fiji differs from the holotype specimen of *D. candidibasis* only by the completely brown fore femora; in the holotype and one other specimen from Fiji the proximal portion of the fore femur is white. The superior volsellae of the specimens are similar; in the specimens with proximally white femora, the superior volsellae are slightly longer (Figs. 30C, D). Unless future reared material of specimens similar to the holotype is examined and shown to be radically different, I am considering all of these specimens to represent *D. candidibasis.*

I am here considering *Ch. melanocnemis* Edwards to be a junior synonym of *D. candidibasis.* I have seen a male from Samoa with genitalia similar to *candidibasis* but with leg color patterns as in *melanocnemis* (known only from the female). The foretibiae are unfortunately missing from this Samoan specimen. Leg color patterns (and other body coloration patterns) seem to be subject to considerable variation in other species of *Dicrotendipes,* and I do not consider them to be good specific characters.

It has been difficult to find morphological characters which will serve to separate females to species. The apodome lobe in the female genitalia may be of use in some instances. Apodome lobes of *candidibasis* and *melanocnemis* "types" are quite similar (Fig. 30E). In addition, in both males and females of both "types," the number of acrostichal setae is very low, or they are absent. I believe that *melanocnemis* is nothing more than a color variant of *candidibasis.*

Edwards (1924) described the hypopygium of *candidibasis* as lacking an anal point. I have mounted the holotype on a microscope slide (in balsam) and have observed that the anal point is contracted beneath T IX, somewhat similar to the anal point of *D. bilobatus.* I have also mounted the female holotype of *melanocnemis* in balsam on a microscope slide. Both types are in the BM.

MATERIAL EXAMINED: FIJI: Lautoka, 11-V-1921, W. Greenwood, 1 male (holotype *Ch. candidibasis*) (BM); Lautoka, 12-VI-1922, R. Veitch, 1 male (BM). Naduruloulou, at light, 8-X-1949, B.A. O'Conner, 5 females (det. *melanocnemis*) (BM); same locality & collector, 10-XI-1949, 1 female (det. *melanocnemis*) (BM). Viti Levu, Laucala Bay (Suva), 13-VI-1985, leg. J. Martin & C.J. Webb, 4 females (JM); Laucala Bay (Suva), egg mass #2, leg. J. Martin, 1 male/Pex/Lex, 2 males, 4 females, 1 pharate female pupa, 4 Pex (JM); Laucala Bay (Suva), egg mass #3, coll. from vegetation at edge of a stream (reared at 20° C), 13-VI-1985, leg. J. Martin, 1 male/Pex, 1 male, 2 pharate male pupae, 1 female/Pex, 2 females, 4 Pex, 2 Lex (JM); Laucala Bay (Suva), grounds of University of the South Pacific, egg mass #4, 13-VI-1985, leg. J. Martin, 7 males, 2 pharate male pupae/Lex, 10 females, 13 Pex, 2 larvae, 4 Lex (JM). SAMOA: Tutuila, Naval Station, at light, 29-VIII-1940, leg. Swezey & Zimmerman, 1 male (det. *melanocnemis*) (US). Upolu, Apia, II-1924, P.A. Buxton & G.H. Hopkins, 1 female (holotype *Ch. melanocnemis*) (BM); Upolu, Tapatapao, 1000 ft., at light, 22-VII-1940, leg. Swezey & Zimmerman, 1 female (US).

Dicrotendipes conjunctus (Walker) (Figs. 31, 39, 40)

nec *Chironomus conjunctus* Loew 1850, in Keilbach 1982:351 *(nomen nudum);* Spahr 1985:22.
Chironomus conjunctus Walker, 1856:425; Skuse 1889:253.
nec *Chironomus blandus* Skuse, 1889:238.
nec *Chironomus blandellus* Kieffer, 1906:16.
nec *Dicrotendipes bilobatus* Kieffer, 1917:222.
Orthocladius conjunctus (Walker): Kieffer 1917:228.
Chironomus (*Dicrotendipes*) *conjunctus* Walker: Freeman 1961a:695.

DIAGNOSIS: The adult male is recognized by the lack of a foretarsal beard, the relatively straight digitiform superior volsella, moderately broad inferior volsella and well developed acrostichal setae. The pupae of *conjunctus* and *pseudoconjunctus* may be inseparable, but in the limited material available to me, *conjunctus* pupae have fewer spines (14–20) on the posterior margin of T V than *pseudoconjunctus* (26–31); both species are distinguished from *cumberlandensis* by the presence of these spines (lacking in *cumberlandensis*). The larva is distinguished by the moderately broad median tooth of the mentum (broader in *cumberlandensis,* narrower in *pseudoconjunctus*) and high strial ridge count (39–45, 42 in *conjunctus,* 29–37, 33 in *cumberlandensis*, 28 in *pseudoconjunctus*).

MALE IMAGO (n = 5)

COLOR (pinned specimens). Head greenish, pedicels light yellow-red-brown; thorax green with light red-brown vittae, scutellum green, postscutellum dark red-brown; abdomen brown with greenish tinge, T VIII and hypopygium brown or abdomen dark green with T VI-IX brown; fore femora green to greenish-stramineous, apices brown; tibiae and tarsi brown; mid and hind femora and tibiae greenish stramineous, metatarsi light brown, darkening apically, remaining tarsomeres brown. Wings immaculate, clear; with light brown veins.

LENGTH (4). Total 4.28–5.73, 4.78 mm. Thorax 1.18–1.58, 1.33 mm. Abdomen 3.10–4.15, 3.45 mm.

HEAD. Setae: temporal 37–53, 43; clypeal 18–25, 21; cibarial 13–16, 14. Palpomere lengths (4): 50–73, 56; 55–68, 61; 143–168, 154; 195–230, 206; 277–315, 293. Frontal tubercles 15–45, 32 long, 8–15, 10 wide. AR 2.28–2.74, 2.52 (4).

THORAX. Scutal tubercle moderately to well developed; humeral pit weak, scarlike or with 2–3 small tubercles. Acrostichals 7–17, 11; dorsocentrals 16–34, 21; scutellars 10–19, 13; prealars 10–11, 10.

WING. Length 2.18–2.68, 2.39 mm; width 0.60–0.75, 0.67 mm. FCu below RM. VR 0.94–0.96, 0.98. Setae: brachiolum 2–4, 3; squama 7–21, 12; R 22–28, 24; R_1 15–21, 18; R_{4+5} 18–30, 24.

LEGS. Foretarsal beard absent. Palmate sensilla chaetica: 9–13, 11 on middle metatarsus, 0 on hind metatarsus. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	1005–1150, 1085	950–1040, 1003	1030–1170, 1106
ti	669–910, 788	850–1030, 932	1100–1370, 1224
ta_1	1305–1500, 1418 (4)	480–540, 509	755–900, 817
ta_2	590–720, 670 (4)	250–285, 264	380–480, 427
ta_3	490–580, 550 (4)	170–220, 190	300–405, 343
ta_4	410–490, 449 (4)	90–140, 109	155–230, 188
ta_5	180–220, 195 (4)	70–115, 91	95–140, 116
LR	1.65–2.08, 1.86 (4)	0.52–0.58, 0.55	0.65–0.69, 0.67
BV	1.67–1.85, 1.73 (4)	3.45–4.11, 3.76	2.79–3.09, 2.94
SV	1.24–1.38, 1.31 (4)	3.71–3.87, 3.80	2.79–2.95, 2.85

ABDOMEN. 1–3 ventral accessory setae on S VI.

HYPOPYGIUM (Fig. 31A) with 5–14, 8 medial setae, set within a weakly defined ovoid area. Gonostylus broad, curved medially, with 5–6 preapical setae. Superior volsella (Figs. 31B, C) length 68–100, 84; width 28–37, 30; LWR 2.5–3.2, 2.8; digitiform with short ventral extension (similar to that of *D. cumberlandensis,* cf. Fig. 32B); with 6–8, 7 sensilla chaetica. Inferior volsella length 145–175, 159; broad and notched slightly apically, with 1–6 sensilla chaetica in 1–4 rows, with 1–2 well developed ventral preapical setae. Anal point bare dorsally, slightly deflexed; with 0 dorsal basal setae and 7–12, 11 lateral basal setae.

FEMALE IMAGO (n = 2)

COLOR (pinned specimens). Head and thorax yellow-brown, with greenish tinge, scutellum green, postscutellum red-brown, abdominal T I-VI green, remainder brown; legs with femora greenish stramineous, tibiae light yellow-brown, metatarsi light yellow-brown proximally, becoming brown apically, remaining tarsomeres brown. Wing immaculate, clear; veins light brown.

LENGTH. Total 4.36 (1) mm. Thorax 1.43 (1) mm. Abdomen 2.93 (1) mm.

HEAD. Setae: temporal 33–38; clypeal 34–35; cibarial 15–17. Palpomere lengths: 50–58; 45–58; 148–172; 198–205; 320–338. Frontal tubercles 10–13 long, 8–9 wide. AR 0.43–0.44.

THORAX. Scutal tubercle well developed; humeral pit a scar with 2–3 tubercles. Acrostichals 14 (1); dorsocentrals 31–32; scutellars 17–20; prealars 8–12.

WING. Length 2.31–3.00 mm; width 0.79 (1) mm. FCu slightly distal to below RM. VR 0.90–0.93. Setae: brachiolum 2–3; squama 13–14; R 23–30; R_1 29–35; R_{4+5} 42–59.

LEGS. Foretarsal beard absent. Palmate sensilla chaetica: 33–43 on middle metatarsus; 0–13 on hind metatarsus. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	1140	1000–1110	1170 (1)
ti	830–840	940–1050	1200–1440
ta_1	1390–1490	475–540	790–880
ta_2	610–680	240–270	370–450
ta_3	520 (1)	190	340–360
ta_4	450 (1)	110–120	170–190
ta_5	210 (1)	100–110	120–125
LR	1.67–1.77	0.51	0.61–0.66
BV	1.88 (1)	3.72–3.97	3.12 (1)
SV	1.33–1.42	4.00–4.08	2.97 (1)

ABDOMEN. 0–7 ventral accessory setae on S VI. Notum 205 (1); cerci 120–153. S VIII with 28–35 setae/side; X with 3–8 setae; Gc IX with 2–7 setae/side.

PUPA: (n = 3)

COLOR. Clear with pale yellow-brown borders.

LENGTH. Total 6.26 (1) mm. Cephalothorax 1.63 (1) mm. Abdomen 3.88–4.63 (2) mm.

CEPHALOTHORAX. Cephalic tubercles well developed (Fig. 39A), 55–70 (2) high, 33–45 (2) wide. Dorsum weakly to well pebbled. Dc_2 closer to Dc_3. Thoracic horn base (similar to *D. pseudoconjunctus,* Fig. 39J) with tracheal bundles narrowly joined to barely separated.

ABDOMEN (similar to *D. pseudoconjunctus,* Fig. 39K). Sternite I with very fine shagreen areas, S II-IV with scattered fine shagreen; S VI with anterior band of fine shagreen; T I with very sparse posterolateral shagreen areas; T II-V with median quadrilateral shagreen areas, with corners somewhat extended laterally; T VI with broadly V-shaped to hourglass-shaped shagreen area; T VII with an anterior pair of suboval shagreen areas; T VIII with an anterior and posterior pair of ovoid fine shagreen areas; shagreen areas on T II-V with spines larger in posterior portion of area, shagreen area on T VI with larger spines anteriorly and posteriorly; T II-IV with posterior area of fine spines. Posterior margin of T II with transverse row of 62–88, 73 hooklets; posterior margin of T V with 2 groups of 5–11 spines (14–20 total). A weak to strong reticulate cuticular pattern present on T IV (VI)-VIII. T VIII with 5 lateral setae. Caudolateral spurs on T VIII (Fig. 39B) 2–5, well developed, sinuate. Anal lobes with 45–73, 56 setae. DR 2.82–3.20, 3.13.

FOURTH INSTAR LARVA: (n = 4)

COLOR. Head capsule light brown to reddish yellow-brown, postmentum darker, postocciput dark-red to black.

HEAD. Postmentum length 247–378, 306. Mandible (Fig. 40A) length 208–298, 239 (3), with 3 triangular lateral teeth; two well developed dorsal teeth present. Pecten mandibularis composed of 14–16, 15 setae. Mentum (Fig. 40B) with 13 teeth, median tooth largest and higher than 1st lateral teeth; width 140–177, 164 (3); MR 2.33–2.45 (2). Ventromental plate with smooth anterior margin; width 125–150, 137; length 53–65, 59. VPR 2.31–2.36, 2.34; IPD 56–64 (2); PSR 2.34–2.64 (2); 39–45, 42 strial ridges. Length of antennal segments: 39–45, 42; 73–107, 91; 21–33, 27; 16–24, 21 (3); 7–8, 7 (3). AR 1.21–1.27, 1.24 (3) (Fig. 40H). Inner blade of premandible subequal to outer blade. Pecten epipharyngis (Fig. 40D) with 11–13, 12 lobes. Frontal apotome (Fig. 40E) with large anteromesal ovoid pit, labral sclerite 1 smooth. S I with about 16 fringes.

BODY. Ventral tubuli absent?

REMARKS. The first species belonging to *Dicrotendipes* described from Australia, *D. conjunctus* has been confused with several other species.

Kielbach (1982:351), in a list of amber insect fossils, records a "*Chironomus conjunctus* Loew, 1850." The name is a *nomen nudum,* for it is recorded only on the paper in which the amber specimen is wrapped; there is no publication with such a name (pers. comm., Odwin Hoffrichter to Jon Martin, 7 May 1984). Spahr (1985) also noted this situation, and listed "*Chironomus conjunctus*" as a "nomenklatorisch unverbindlicher Etikettenname" (nomenclaturally non-binding label-name).

Freeman (1961a) considered *Ch. blandellus* Kieffer (*nomen novum* for *Ch. blandus* Skuse, which was a junior objective primary homonym of *Ch. blandus* van der Wulp, 1858) a synonym of *conjunctus.* The only extant specimen is the female holotype. I have examined this specimen (housed in the AN) and conclude that it is not a *Dicrotendipes.* I have mounted the pinned specimen in balsam on a microscope slide. The specimen's ventrolateral lobe is very reduced, the apodome lobe is well developed with numerous microtrichia and the labia bear microtrichia; the species probably is a member of *Chironomus, Einfeldia* or another closely related genus.

Dicrotendipes bilobatus was also considered a synonym of *conjunctus* by Freeman (1961a); I am treating *bilobatus* here as a separate entity. See remarks under *D. bilobatus.*

Freeman (1961a) noted that more than 1 species may have been present in his *conjunctus* material. He found differences in the apical width of the inferior volsella and the extent of the foretarsal beard. He correctly stated that all existing names applied to specimens with broader appendages and no beard, i.e., *D. conjunctus.* Specimens with narrower inferior volsellae and a tarsal beard are *D. pseudoconjunctus.* At least a third similar species occurs with no tarsal beard and much broader (than *conjunctus*) inferior volsellae, *D. cumberlandensis* (q.v.).

In an unpublished Master's thesis, Martin (1961) briefly described the larva of *D. conjunctus* [as *Chironomus* (*Dicrotendipes*) *conjunctus* form C] with a "pair of quite long ventral tubuli on the penultimate segment." I have not examined any material of this species with such tubuli. Ventral tubuli are often present or absent on several other species of *Dicrotendipes* (Epler 1987a). Edward (1964) also described the larva and the pupa of *D. conjunctus.* He found the larvae inhabiting "algal mats and slime in permanent and temporary waters."

I have examined the type series of *conjunctus,* housed in the BM. It consists of a male and female, both pinned. The male bears the following labels: conjunctus n.s./VDL/Type; the female: VDL/68.4/Type. Because both specimens bear a type label, they must be considered syntypes. I hereby

designate the male as the lectotype and the female as a paralectotype for *Chironomus conjunctus* Walker. I have remounted both specimens in balsam on microscope slides.

MATERIAL EXAMINED: AUSTRALIA: Australian Capital Territory: Canberra, pond margin, 21 Nov 1956, leg. W.W. Wirth, 1 male (US). New South Wales: The Beardy Waters, nr Glenn Innes, 9-I-1968, leg. J. Martin, 1 male (JM); Boggy Swamp Creek on the Putty Road, 28-VIII-1981, leg. J. Martin, 2 males/Pex/Lex (JM); Deewhy, South Creek, 27 Sept 1956, leg. W.W. Wirth, 9 males (US, BM), same locality & collector, 23 Oct 1956, 3 males (US); Hornsby, at light, 6-8-I-1959, 1 male, 2 females [?] (BM). [Northern Territory]: V[an] D[ieman's] L[and], 1 male, 1 female (lectotype, paralectotype *Ch. conjunctus*) (BM). Tasmania: Advent Bay, 1 Jan 1922, leg. A. Tonnoir, 1 male (BM). Victoria: Botanic Gardens, Melbourne, 28-VIII-1963, leg. J. Martin, 1 male (JM); Chiltern, leg. J. Martin, 1 male (JM); Echuca, leg. J. Martin, 1 male (JM); Lorne, 5-III-1958, N. Dobrotworsky, 1 male (BM); Narbethong, 18-III-1958, N. Dobrotworsky, 3 males (BM); You Yangs, approx. 20 mls. SW Melbourne, 6-VII-1971, leg. J. Martin, 1 female/Pex/Lex (JM). No data, J. Martin, 1 Pex/Lex (JM).

Dicrotendipes cumberlandensis sp. nov. (Figs. 32, 39, 40)

TYPE LOCALITY: Cumberland River, 8 km S of Lorne, Victoria, Australia.

TYPE MATERIAL: **Holotype:** male/Pex/Lex, AUSTRALIA: Victoria: Cumberland River 8 km S of Lorne, 4-X-1967, leg. Jon Martin (JM). **Paratypes** (18): Queensland: Barron River, 100 m below Tinnaroo Dam Spillway, on *Hydrilla,* 18-X-1982, leg. J.K. Balciunas, 1 female/Pex (JB). Victoria: same data as holotype, 1 male/Pex/Lex, 1 female/Pex, 1 pharate female pupa/Lex, 2 larvae (JM); same data as holotype except 16-X-1967, 1 male, 1 female/Pex/Lex, 2 females/Pex, 1 female/Lex, 1 pharate female pupa/Lex, 6 larvae (JM). The holotype will be deposited in the AN; paratypes will be placed in BM, FS and JE.

ETYMOLOGY. This species is named for the Cumberland River, its type locality.

DIAGNOSIS: The adult male can be distinguished from the similar *D. conjunctus* and *D. pseudoconjunctus* by the massive inferior volsellae and by the absence of acrostichal setae. The female can be distinguished by the absence of acrostichal setae, which are replaced by setae-less pits. See diagnosis under *conjunctus* for pupae and larvae.

MALE IMAGO (n = 3)

COLOR (slide mounted specimens). Head, thorax and abdomen brown; fore femora light brown with darker distal apex, fore tibiae light brown with darker proximal and distal apices, mid and hind femora and tibiae light brown, all metatarsi light brown with darker apices, other tarsomeres brown. Wings immaculate with light brown veins.

LENGTH. Total 5.53–5.98 (2) mm. Thorax 1.48–1.50 (2) mm. Abdomen 3.18–4.48, 3.90 mm.

HEAD. Setae: temporal 35–43, 39; clypeal 14 (2); cibarial 17–19 (2). Palpomere lengths (2): 50–60; 73–95; 177–190; 225; 320–350. Frontal tubercles 18–22, 20 long, 6–8, 7 wide. AR 2.18–2.43, 2.30.

THORAX. Scutal tubercle moderately to well developed; humeral pit weak, scarlike or with 2–3 small tubercles. Acrostichals absent, 8–10 setae-less pits present; dorsocentrals 10–21, 16; scutellars 9–12, 11; prealars 9–10, 9.

WING. Length 2.38–2.93, 2.73 mm; width 0.67–0.79, 0.72 mm. FCu distal or below RM. VR 0.92–0.95, 0.94. Setae: brachiolum 2; squama 6–9, 7; R 27–28, 27; R_1 20–23, 21; R_{4+5} 27–38, 34.

LEGS. Foretarsal beard absent. Palmate sensilla chaetica: 14–19, 16 on middle metatarsus, 0 on hind metatarsus. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	1115–1390, 1278	1040–1260, 1177	1110–1360, 1223
ti	780–1020, 907	915-1165, 1050	1150–1520, 1353
ta_1	1350–1870, 1590	540–680, 600	790–1030, 907
ta_2	570–790, 670	275–340, 298	390–500, 447
ta_3	475–620, 547	180–230, 202	275–380, 332
ta_4	380–480, 303	110–130, 118	140–190, 170
ta_5	180–195, 190	90–105, 100	115–130, 125
LR	1.68–1.83, 1.75	0.54–0.59, 0.57	0.65–0.69, 0.67
BV	2.02–2.07, 2.05	3.81–4.14, 3.94	3.17–3.32, 3.25
SV	1.29–1.45, 1.38	3.57–3.97, 3.72	2.80–2.88, 2.84

ABDOMEN. 0–1 ventral accessory setae on S VI.

HYPOPYGIUM (Figs. 32A, B) with 5–12, 8 medial setae, set within a weakly defined ovoid area. Gonostylus broad, curved medially, with 6–7 preapical setae. Superior volsella (Fig. 32C) length 93–95 (2); width 28–30 (2); LWR 3.2–3.3 (2); digitiform with short ventral extension, slightly curved mediad; with 9–10, 9 sensilla chaetica. Inferior volsella length 180–195 (2); apex extremely broad and notched slightly, with 1–7 sensilla chaetica in 2–3 rows, with 2–3 well developed ventral preapical setae. Anal point bare dorsally, slightly deflexed; with 0 dorsal basal setae and 13–20, 16 lateral basal setae.

FEMALE IMAGO (n = 3)

COLOR. Similar to male.

LENGTH. Total 3.80–5.53, 4.95 mm. Thorax 1.05–1.65, 1.44 mm. Abdomen 2.75–3.90, 3.51 mm.

HEAD. Setae: temporal 33–38, 36; clypeal 16–20, 18; cibarial 11–16, 14. Palpomere lengths: 58–75, 68; 55–80, 70; 138–190, 168; 167–247, 218, 173–385, 314. Frontal tubercles 3–15, 10 long, 7–8, 7 wide. AR 0.32–0.39, 0.36.

THORAX. Scutal tubercle well to moderately developed; humeral pit indiscernible. Acrostichals absent, 7–8 setae-less pits present; dorsocentrals 9–17, 14; scutellars 9–12, 11; prealars 8–10, 9.

WING. Length 2.70–3.53, 3.21 mm; width 0.84–1.09 (2) mm. FCu distal to RM. VR 0.86–0.89 (2). Setae: brachiolum 2–3, 2; squama 8–14, 11; R 21–31, 27; R_1 21–35, 29; R_{4+5} 48–52 (2).

LEGS. Foretarsal beard absent. Palmate sensilla chaetica: 25–27, 26 on middle metatarsus; 2–15, 6 on hind metatarsus. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	1115–1510, 1375	1080–1390, 1283	1160–1470, 1357
ti	790–1090, 987	990–1240, 1152	1250–1630, 1490
ta_1	1550–2055, 1878	530–720, 647	810–1120, 993
ta_2	660–850, 763	260–350, 313	420–510, 474
ta_3	530–695, 623	180–245, 218	295–380, 348
ta_4	410–555, 495	110–140, 128	160–190, 180
ta_5	170–215, 193	100–120, 113	110–140, 127
LR	1.86–1.96, 1.91	0.54–0.58, 0.56	0.65–0.69, 0.67
BV	1.23–1.26, 1.24	3.91–4.06, 3.99	3.27–3.49, 3.40
SV	1.23–1.28, 1.26	3.64–3.91, 3.78	2.77–2.98, 2.88

ABDOMEN. 0–4 ventral accessory setae on S VI. Notum 170–245, 206 (4); cerci 110–180, 152. S VIII with 24–47, 36 setae/side; X with 1–10, 6 (4) setae; Gc IX with 0–1, 1 (4) setae/side.

PUPA: (n = 8)

COLOR. Light yellow-brown with darker borders.

LENGTH (5) Total 5.13–6.98, 6.23 mm. Cephalothorax 1.43–1.68, 1.57 mm. Abdomen 3.70–5.34, 4.66 mm.

CEPHALOTHORAX. Cephalic tubercles well developed (Fig. 39C), 53–58 (2) high, 100–133 (2) wide. Dorsum moderately to well pebbled. Dc_2 closer to Dc_3 (Fig. 39D). Thoracic horn base (Figs. 39E, F) with tracheal bundles narrowly joined to barely separated.

ABDOMEN (Fig. 39G). Sternites II-V with very fine shagreen areas; T II with broadly V-shaped median shagreen area with shagreen larger in posterior portion; T III-IV with median quadrilateral shagreen areas; T V-VI with somewhat lyrate shagreen areas; T VII with an anterior pair of suboval shagreen areas; T VIII with an anterior and posterior pair of ovoid fine shagreen areas; shagreen smallest in anterior portion of areas on T III-VI, subequal over rest of area; shagreen areas on T IV and V with distinctive adjoining area of fine spine bands

in posterior portion of area. Posterior margin of T II with transverse row of 63–92, 74 hooklets. A weak reticulate cuticular pattern present on posterior portion of T VII. T VIII with 5 lateral setae. Caudolateral spurs on T VIII (Figs. 39H, I) 1–3, well developed, sinuate, often with smaller basal spurs. Anal lobes with 39–82, 56 (7) setae. DR 2.48–3.38, 2.88 (7).

FOURTH INSTAR LARVA: (n = 5)

COLOR. Head capsule yellow-brown or reddish yellow-brown to brown, postmentum and genae darker, frontal apotome with darker borders on posterior ¾, labral sclerite 1 darker brown. Head capsule integument with grainy appearance.

HEAD. Postmentum length 240–320, 282 (3). Mandible length 253–265 (2), with 3 triangular lateral teeth; two dorsal teeth present. Pecten mandibularis composed of 10–15, 12 (3) setae. Mentum (Fig. 40F) with 13 teeth, median tooth broadly rounded; width 145–200, 173 (4); MR 2.67 (1). Ventromental plate with mostly smooth anterior margin; width 107–124, 115; length 53–70, 60. VPR 1.77–2.09, 1.94; IPD 65–89, 74 (4); PSR 1.39–1.69, 1.55 (4); 29–37, 33 strial ridges. Length of antennal segments (4): 62–88, 74; 18–20, 19; 12–13, 12; 15–19, 16; 7–8, 7. AR 1.13–1.60, 1.35 (Fig. 40G). Inner blade of premandible greater than outer blade. Pecten epipharyngis (Fig. 40H) with 3–6 (2) lobes. Frontal apotome (Fig. 40I) with large ventral anteromesal ovoid pit, labral sclerite 1 smooth, S I with 6–11, 9 (4) fringes.

BODY. Ventral tubuli absent.

REMARKS. A large species similar to *D. conjunctus, D. cumberlandensis* has distinctive large inferior volsellae and lacks acrostichal setae. In their place is a series of indentations; there is no trace of setae or their sockets.

The pupa lacks the hooklets usually found at the posterior margin of T V in pupae of this group.

Dicrotendipes flexus (Johannsen) (Fig. 41)

Chironomus (*Limnochironomus*) *flexus* Johannsen, 1932:530.
Limnotendipes flexus (Johannsen): Lenz 1937:6.
Dicrotendipes flexus (Johannsen): Sublette & Sublette 1973:403; Hashimoto et al. 1981:14; Sasa 1985:33.

DIAGNOSIS. The adult male strongly resembles *D. nervosus* (Staeger), but can be separated by the apparently disjunct distributions and fewer setae on R & R_1, (21–26 in *flexus*, over 35 in *nervosus*). The bizarre pupa is distinguished by the distinctive shagreen. The larva is separated by its distinctive mentum with the 1st and 2nd laterals almost completely fused.

See adult description in Johannsen (1932:530) and Hashimoto et al. (1981:14). The female is undescribed.

PUPA: (n = 2)

COLOR. Light yellow-brown to light brown.

LENGTH. Total about 4.20 (1) mm and larger. Cephalothorax about 1.20 (1) mm. Abdomen 3.00–4.20 mm.

CEPHALOTHORAX. Cephalic tubercles very small to essentially absent. Dorsum moderately to roughly pebbled. Dc_2 closer to Dc_1. Thoracic horn base (Fig. 41A) with tracheal bundles separated.

ABDOMEN. (Fig. 41B). Sternite I with well developed large shagreen spinules; S II-III with well developed lateral shagreen bands and median shagreen areas; S IV with median fine shagreen area and posterior area of well developed shagreen spinules; S V-VII with anterior shagreen areas, S VIII with anterior shagreen area and posterior area of well developed spinules; T II-VII with median quadrilateral shagreen areas, posterior shagreen spinules larger except on T V-VI where median group of large spines present immediately posterior to small median bare area; T VIII with broadly T-shaped shagreen area with posterior lateral extensions from arms of "T"; anal disc with well developed shagreen pattern on anterior ½; T II-VI with lateral longitudinal shagreen bands; T III (IV)-V with posterior band of very fine spinules. Posterior margin of T II with transverse row of 70–95 hooklets. T VIII with 4 lateral setae. Caudolateral spurs on T VIII (Fig. 41C) single, thorn-like. Anal lobes with 97–156 setae. DR 1.80 (1).

FOURTH INSTAR LARVA: (n = 3)

COLOR. Head capsule light yellow-brown; postmentum darker.

HEAD. Postmentum length 218–273, 243. Mandible length 168–185 (2), with 3 triangular lateral teeth; one dorsal tooth present. Pecten mandibularis composed of 8–10, 9 setae. Mentum (Fig. 41D) with 13 teeth, 2nd lateral teeth reduced and fused to 1st laterals, giving appearance of notched 1st lateral teeth; width 120–130, 126; MR 2.42–2.73 (2). Ventromental plate with shallow crenulations; width 82–105, 92; length 44-52, 48; VPR 1.74–2.02, 1.92; IPD 59–61 (2); PSR 0.75–0.85 (2); 21–23, 22 strial ridges. Length of antennal segments: 51–60, 55; 18–22, 20; 10–11, 11; 11–14, 12; 5–6, 5. AR 1.06–1.20, 1.14 (Fig. 41E). Inner blade of premandible greater than outer blade. Pecten epipharyngis (Fig. 41F) with 3 lobes. Frontal apotome (Fig. 41G) with small, poorly developed (or barely visible) anteromedian frontal pit; labral sclerite 1 smooth. S I with about 8–13 fringes.

BODY. Ventral tubuli absent.

REMARKS. The pupa of *flexus* is most unusual for a *Dicrotendipes*. No other species in the genus displays such heavy ventral shagreen and spination, and such extensive shagreen areas on T VII-VIII.

A holotype and paratype are present in the BM. Both specimens are in alcohol in microvials; their hypopygia are mounted on microscope slides. There are few data in the microvials or on the slides, but code numbers are with the specimens. These numbers correspond to the numbers given in Lenz (1937) in his material examined (Vorkommen) listed at the end of each species account. Johannsen (1932) also lists locality data, but does not give the year in which the specimens were collected. Johannsen's figure of *flexus* (Johannsen 1932:Fig. 18) is of the distorted, upside down paratype's hypopygium; the holotype mount is much better, and one wonders why the poorer specimen was illustrated.

MATERIAL EXAMINED: AUSTRALIA: Northern Territory: Berry Springs, 57 km S. of Darwin, on *Hydrilla,* 4-X-1982, leg. J.K. Balciunas, 1 pharate male pupa/Lex (JB); same collection data except at UV light, 1 male (JB). [INDONESIA]: [JAVA]: Ostjava, R. Bedali, Ufer, 15-X-1928, (L4), 1 male (holotype *Ch. flexus*) (BM); Ostjava, R. Bedali; *Lyngbya*-Zone

(2-6 m Tiefe) 22-XI-1928, leg. Thienemann, (L26), (ZS). Sumatra: N. Sumatra, Lake Toba, along NE shore Samosir Is., ½ km N of Simanindo, on *Potamogeton,* 12-IX-1981, leg. J.K. Balciunas, 1 larva (JB); Lake Toba at Tuk-Tuk, 8 km WSW of Prapat, at UV light, 6-VIII-1982, leg. J.K. Balciunas, 1 male (JB). Sudsumatra: Ranau-See, Oberflache, 21-I-1929, 1 male, (R4a), (paratype *Ch. flexus*) (BM); Heisse Quellen am Ranau-See, 40°, *Lyngbya*-Zone, 5-II-1929, leg. A. Thienemann, (R38), 1 pharate male pupa (ZS).

Dicrotendipes jobetus sp. nov. (Fig. 32)

TYPE LOCALITY: Katherine Gorge, Northern Territory, Australia.

TYPE MATERIAL: **Holotype:** male, AUSTRALIA: Northern Territory: Katherine Gorge, 15 km NE Katherine, open *Spinifex-Eucalyptus* woodland, 6-8-XI-1984, leg. B. & M. Baehr (ZS). **Paratype** (1): AUSTRALIA: W. Australia: Young River Station, outpost camp lake, 11-12-1959, leg. D.H. Edward, 1 male (BM). Holotype to be deposited in ZS; paratype in BM.

DIAGNOSIS: The adult male is distinguished by its distinctive superior volsella. The female and immature stages are unknown.

ETYMOLOGY. The name is an anagram constructed from the names of my parents, John and Betty Epler, for whom I am quite pleased to name this species.

MALE IMAGO (n = 2)

COLOR (pinned specimen). Head, thorax and abdomen brown. Forelegs light brown, distal ½ of femur darker, base of metatarsus lighter brown; mid and hind legs light brown, distal ½ of metatarsi and other tarsomeres darker brown. Wings immaculate, clear; with brown veins.

LENGTH. Total 3.23–4.75 mm. Thorax 0.88–1.35 mm. Abdomen 3.23–4.75 m.

HEAD. Setae: temporal 30–42; clypeal 15–21; cibarial 11–18. Palpomere lengths: 40–57; 50–75; 107–140; 145–183; 213–310. Frontal tubercles (1) 20 long, 7 wide. AR 2.11–2.53.

THORAX. Scutal tubercle well developed; humeral pit with 1–5 large tubercles. Acrostichals 7–13; dorsocentrals 13–24; scutellars 11–16; prealars 8–11.

WING. Length 1.45–2.25 mm; width 0.44–0.65 mm. FCu below to slightly distal to RM. VR 0.91–0.95. Setae: brachiolum 2; squama 6–9; R 8–17; R_1 0–1; R_{4+5} 2.

LEGS. Foretarsal beard absent. Palmate sensilla chaetica: 5–10 on middle metatarsus, 0 on hind metatarsus. Lengths and proportions of legs, p. 131.

ABDOMEN. Flattened setae not apparent on S VI.

HYPOPYGIUM (Fig. 33A) with 4–5 medial setae. Gonostylus normal, slightly curved medially, with 4–6 preapical setae. Superior volsella (Fig. 33B) length 60–83; width 30–53; LWR 1.6–2.0; obovate, widest apically, with 12 sensilla chaetica. Inferior volsella length 108–175; apex slightly notched, with 4–5 sensilla chaetica in 2 rows, with 1 well developed ventral preapical setae. Anal point bare dorsally, slightly deflexed; with 6–8 lateral basal setae.

	P_1	P_2	P_3
fe	720–1010	620–910	670–965
ti	490–730	505–860	730–1100
ta_1	880 (1)	300–465	470–710
ta_2	430 (1)	150–240	250–375
ta_3	345 (1)	110–185	205–300
ta_4	270 (1)	70–120	110–175
ta_5	135 (1)	65-100	85–120
LR	1.80 (1)	0.54–0.59	0.64–0.65
BV	1.77 (1)	3.47–3.61	2.86–2.88
SV	1.38 (1)	3.75–3.81	2.91–2.98

Dicrotendipes jonmartini sp. nov. (Figs. 34, 42)

TYPE LOCALITY: Cook, South Australia.

TYPE MATERIAL: **Holotype:** male, [AUSTRALIA]: Cook, South Australia, from egg mass #1, [no date], leg. Jon Martin & B.T.O. Lee (JM). **Paratypes** (5): W. Australia: Shark Lake, Nth Esperance, 10-XII-1959, leg. D.H. Edward, 1 male (BM). Same data as holotype, 2 Pex, 2 larvae (JM). Holotype to be deposited in AN; paratypes in BM, AN, JE.

DIAGNOSIS: The adult male is distinguished by the pediform superior volsella and by its inferior volsella with its dorsal membranous extension. The female is unknown. The pupa is very similar to *D. sarinae* and may be inseparable; in the material available to me it is distinguished by the lower number of T II hooklets and higher number of spines on the posterior margin of T V. The larva possesses a granular head capsule integument and is distinguished from *D. sarinae* by the higher ventromental strial count and higher VPR and PSR.

ETYMOLOGY. I take great pleasure in naming this species for Dr. Jon Martin, who has been of immeasurable assistance during this study.

MALE IMAGO (n = 2)

COLOR (pinned specimen). Head, thorax, abdomen and legs brown. Wings immaculate; clear with light yellow-brown veins.

LENGTH. Total 4.03–4.65 mm. Thorax 1.15–1.25 mm. Abdomen 4.03–4.65 mm.

HEAD. Setae: temporal 31–43; clypeal 16; cibarial 15–19. Palpomere lengths: 50–53; 53–60; 128–135; 155–170; 277–293. Frontal tubercles 10–18 long, 9 wide. AR 2.55–2.66.

THORAX. Scutal tubercle well developed; humeral pit with 5–12 small to large tubercles. Acrostichals 11–13; dorsocentrals 20–27; scutellars 10–11; prealars 9–11.

WING. Length 1.70–2.00 mm; width 0.52–0.61 mm. FCu below to slightly proximal to RM. VR 0.98–1.00. Setae: brachiolum 2; squama 12 (1); R 11–12; R_1 0–2; R_{4+5} 2.

LEGS. Foretarsal beard absent. Palmate sensilla chaetica: 7–14 on middle metatarsus, 0 on hind metatarsus. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	790–845	760–780	840–890
ti	600–640	720–760	945–990
ta_1	940–980	330–360	640–650
ta_2	440–445	190–205	340
ta_3	395–400	155–170	290–300
ta_4	310	95–100	160
ta_5	160–165	80–85	110
LR	1.53–1.57	0.46–0.47	0.66–0.68
BV	1.78–1.87	3.39–3.48	2.69–2.78
SV	1.48–1.52	4.28–4.48	2.79–2.89

ABDOMEN. Flattened setae not apparent on S VI.

HYPOPYGIUM (Fig. 34A) with 7–15 dorsomedial setae. Gonostylus broad, almost straight medially, with 6 preapical setae. Superior volsella (Fig. 34B) length 58–63; width 43–47; LWR 1.2–1.5; pediform, with 5–6 sensilla chaetica. Inferior volsella with membranous dorsal extension, length 107–110; apex slightly notched, with 2–4 sensilla chaetica in 2–3 rows, with 4 well developed ventral preapical setae. Anal point bare dorsally, slightly deflexed; with 5–8 lateral basal setae.

PUPA: (n = 2)

COLOR. Mostly clear, cephalothorax light yellow-brown.

LENGTH. Total 4.68–4.83 mm. Cephalothorax 1.18–1.28 mm. Abdomen 3.50–3.55 mm.

CEPHALOTHORAX. Cephalic tubercles small. Dorsum moderately pebbled. Dc_2 closer to Dc_1. Thoracic horn base (Fig. 42A) with tracheal bundles narrowly joined.

ABDOMEN (Fig. 42B). Sternite I with weak anterolateral shagreen areas; S II-III with anterior and lateral fine shagreen areas; S VI-VIII with paired oval areas of fine shagreen; T I with weak anterolateral shagreen areas, T II with broadly T-shaped median shagreen area, T III-VI with median quadrilateral shagreen areas; T VII with anterior pair of ovoid shagreen areas; T VIII with anterior and posterior pairs of ovoid shagreen areas; shagreen on T III-VI larger medially. Posterior margin of T II with transverse row of 76–78 hooklets; T V with posterior continuous band of 42–44 spines. A weak reticulate cuticular pattern present on posterolateral portion of T VII. T VIII with 5 lateral setae. Caudolateral spurs on T VIII (Figs. 42C, D) 1–3, well developed, sinuate. Anal lobes with 31–33 setae. DR 2.11–4.50.

FOURTH INSTAR LARVA: (n = 2)

COLOR. Head capsule light brown with no postmental darkening. Head capsule integument with grainy appearance.

HEAD. Postmentum length 215 (1). Mandible length 188–190, with 3 triangular lateral teeth; 2 dorsal teeth present. Pecten mandibularis composed of 14–15 setae. Mentum (Fig. 42E) with 13 teeth, width 123–128; MR 2.86–3.00. Ventromental plate with smooth anterior margin; width 119–121; length 52–53; VPR 2.28–2.29; IPD 34–37; PSR 3.27–3.50; 35–40 strial ridges. Length of antennal segments (1): 69; 18; 13; 14; 7. AR 1.33 (1). (Fig. 42F). Inner blade of premandible greater than outer blade. Pecten epipharyngis with 3 lobes. Frontal apotome (Fig. 42G) with elongate-oval frontal pit, labral sclerite 1 smooth. S I with 8–9 fringes.

BODY. Ventral tubuli absent.

REMARKS. This species is very similar to *D. sarinae* in all life stages. It is possible that the *sarinae* material (all reared from 1 egg mass) may be aberrant *jonmartini.*

Dicrotendipes leei (Freeman)

Chironomus (*Dicrotendipes*) *leei* Freeman, 1961a:691.

See adult description in Freeman (1961a:691). The immature stages are unknown.

MATERIAL EXAMINED: AUSTRALIA: New South Wales: Hornsby, 6-I-1958, leg. D.J. Lee, 1 male (holotype) (SP); same data except 9-XII-1958, 1 male (paratype) (BM); same data except light trap, 7-II-1957, 1 female (without abdomen) (paratype) (SP); same data except 6-8-I-1959, (no collector data), 1 female (BM).

Dicrotendipes lindae sp. nov. (Fig. 35)

TYPE LOCALITY: Paradise River near Marion, Queensland, Australia.

TYPE MATERIAL: **Holotype:** male, AUSTRALIA: Queensland: Paradise River bei Marion, 25 km W Mackay, 22-12-1981, leg. M. Baehr (ZS). **Paratype** (1): AUSTRALIA: Northern Territory: 30 km N Adelaide River, tropical savannah woodland, 5-6-11-1984, leg. B. and M. Baehr, 1 male (ZS). Holotype and paratype in ZS.

DIAGNOSIS: The striking coloration of the body and wings, pediform superior volsella and long median volsella will distinguish this species. The female and immature stages are unknown.

ENTYMOLOGY. I take great pleasure in naming this beautiful species for my beautiful wife, Linda.

MALE IMAGO (n = 2)

COLOR (slide mounted specimens). Head, thorax and abdomen brown, abdominal T II-V with darker, narrow longitudinal band, wider on T VI and VII; posterior ⅓ of T VII and VIII lighter brown. Hypopygium brown, gonostyli and inferior volsellae white. Legs with all coxae dark brown; femora dark brown with light brown extreme distal and proximal apices and broad light brown median band; tibiae dark brown with light brown extreme proximal apices and median band; metatarsi light brown proximally, remainder of segment and following tarsomeres dark brown. The proximal dark brown band on the mid and hind tibiae is smaller than that on the fore tibia. Wings light dusky brown with darker clouds running from RM along R_{4+5} for approximately ¾ of its length, along Cu and in a band from the vannal fold to M_{3+4}, along and distal to AN, and along the alula; veins dark brown. The microtrichia within the dark clouds display a polygonal pattern at 100X.

LENGTH. Total 4.13–4.88 mm. Thorax 1.03–1.25 mm. Abdomen 3.10–3.63 mm.

HEAD. Setae: temporal 30–35; clypeal 18–19; cibarial 10 (1). Palpomere lengths: 48–55; 43–53; 137–180; 175–213; 243–297. Frontal tubercles 13 long, 10 wide. AR 2.13–2.38.

THORAX. Scutal tubercle well developed; humeral pit with about 8 small to large tubercles. Acrostichals 10–12; dorsocentrals 23–39; scutellars 11–16; prealars 9.

WING. Length 1.60–2.06 mm; width 0.45–0.62 mm. FCu slightly distal to or below RM. VR 0.92–0.96. Setae: brachiolum 2; squama 14; R 12–14; R_1 11–13; R_{4+5} 5–8.

LEGS. Foretarsal beard absent. Palmate sensilla chaetica: 3–4 on middle metatarsus, 0 on hind metatarsus. Lengths and proportion of legs:

	P_1	P_2	P_3
fe	810–1050	760–915	840–1040
ti	610–775	665–870	895–1100
ta_1	1040–1350	350–460	610–720
ta_2	530–625	190–240	340–390
ta_3	410–510	115–170	270–305
ta_4	320–415	55–70	95–115
ta_5	160–190	60–70	90–95
LR	1.70–1.74	0.53	0.65–0.68
BV	1.73–1.82	4.08–4.23	2.95–3.16
SV	1.35–1.37	3.88–4.07	2.84–2.97

ABDOMEN. Flattened setae on S VI not apparent.

HYPOPYGIUM (Fig. 35A) with 16–18 dorsomedial setae. Gonostylus normal, slightly curved medially, with 4–7 preapical setae. Superior volsella (Fig. 35B) length 90–98; width 38–53; LWR 1.8–2.4; pediform, with 4 sensilla chaetica. A long thin membranous median volsella present laterad to base of superior volsella. Inferior volsella length 148–170; simply clubbed, with 4 sensilla chaetica in 2 rows; with 1 well developed ventral preapical seta. Anal point bare dorsally, deflexed; with 7–9 lateral basal setae.

Dicrotendipes pelochloris (Kieffer) (Figs. 36, 41, 50)

Tendipes pelochloris Kieffer, 1912:39; Kieffer 1916:113; Sublette & Sublette 1973:413 (listed as unplaced species of Chironomini).
Limnochironomus niveicauda Kieffer, 1921b:585. **NEW SYNONYMY.**
Chironomus (*Limnochironomus*) *niveicauda* (Kieffer): Johannsen 1932:528.
Chironomus inferior Johannsen, 1932:534. **NEW SYNONYMY.**
Cladotendipes inferior (Johannsen): Lenz 1937:7.
Chironomus (*Dicrotendipes*) *wirthi* Freeman, 1961a:692. **NEW SYNONYMY.**
Dicrotendipes inferior (Johannsen): Sublette & Sublette 1973:403.
Dicrotendipes niveicauda (Kieffer): Sublette & Sublette 1973:404; Hashimoto et al. 1981:13.
Kimius hoonsooi Ree, 1981:218; Sasa & Hasegawa 1983:321. **NEW SYNONYMY.**
Dicrotendipes niveicaudus (Kieffer): Sasa & Hasegawa 1983:321.
Xenochironomus loripes Guha et Chaudhuri, 1981:163. **NEW SYNONYMY.**
Einfeldia loripes (Guha et Chaudhuri): Chaudhuri & Guha 1987:27. **NEW SYNONYMY.**

DIAGNOSIS: The adult male is distinguished by the distinctive hypopygium with its sharply deflexed anal point and distinctive superior volsella. The female can usually be identified by its color pattern, and by the distinctive apodome lobe with well developed microtrichia. The pupa is separated by the shagreen pattern and 5 lateral lamellar setae on T VIII (see key); the larva can be separated by its distinctive mentum.

MALE IMAGO (n = 7)

COLOR (slide and alcohol specimens). Head and thorax brown to dark brown, abdominal T I-V yellow-green to green to dark brown, T VI-IX dark brown, gonostyli white to light brown. Legs with coxae yellow-white, femora with proximal 1/8–1/2 yellowish-white to white, distal portion dark brown; tibiae dark brown; fore metatarsus with proximal ½–⅔ yellowish-white to white with distal portion dark brown or complete metatarsus dark brown, remaining fore tarsomeres light brown to brown; ta_1 and ta_2 of mid and hind legs yellowish-white to white with distal apices brown, remaining tarsomeres brown, occasionally lighter proximally. Wings hyaline to dusky brown, some specimens with diffuse brown cloud along R_1, R_{4+5}, M, Cu and An; veins brown.

LENGTH. Total 3.74–4.40, 4.01 (4) mm. Thorax 1.06–1.25, 1.14 (4) mm. Abdomen 2.65–3.48, 2.99 (6) mm.

HEAD. Setae: temporal 43–53, 49; clypeal 11–23, 19; cibarial 8–12, 10. Palpomere lengths: 43–50, 47 (6); 47–63, 54 (6); 117–174, 140 (6); 158–195, 176 (5); 220–300, 265 (6). Frontal tubercles 16–26, 20 long, 7–10, 8 wide. AR 1.95–2.27, 2.09.

THORAX. Scutal tubercle moderately to well developed; humeral pit with 3–5 moderate tubercles. Acrostichals 9–14, 12; dorsocentrals 15–17, 16; scutellars 6–10, 8; prealars 7–10, 9.

WING. Length 1.73–2.28, 1.96 mm; width 0.51–0.67, 0.57 mm. FCu distal to RM. VR 0.81–0.92, 0.85. Setae: brachiolum 2–3, 2; squama 3–13, 7; R 14–25, 19; R_1 13–18, 15; R_{4+5} 18–24, 20.

LEGS. Foretarsal beard absent or very slight. Palmate sensilla chaetica: 11–18, 16 on middle metatarsus, 0–9, 4 on hind metatarsus. Lengths and proportions of legs (6):

	P_1	P_2	P_3
fe	885–1080, 962	850–1030, 913	970–1120, 1021
ti	610–770, 670	790–890, 795	940–1150, 1013
ta_1	1140–1280, 1247 (5)	370–475, 411	590–770, 654
ta_2	510–600, 556 (5)	180–260, 209	290–405, 339
ta_3	420–520, 462 (5)	130–170, 147	250–340, 286
ta_4	320–410, 357 (5)	55–80, 74	110–160, 143
ta_5	150–180, 167 (5)	55–80, 74	85–110, 102
LR	1.66–2.07, 1.86 (5)	0.49–0.54, 0.52	0.62–0.68, 0.64
BV	1.78–1.98, 1.89 (5)	4.06–4.74, 4.22	2.99–3.44, 3.10
SV	1.20–1.45, 1.33 (5)	3.98–4.38, 4.17	2.93–3.24, 3.12

ABDOMEN. 1-3 ventral accessory setae on S VI.

HYPOPYGIUM (Figs. 36A, B, C) with 10–16, 13 medial setae, apparently set within a weakly defined ovoid area. Gonostylus broad, curved slightly medially, with 6–9, 8 preapical setae. Superior volsella (Figs. 36D, E, F) length 65–77, 70 (6); width 31–40, 35 (6); LWR 1.8–2.2, 2.0 (6); somewhat digitiform, often with expanded apex directed mediad; with 2–4, 3 sensilla chaetica. Inferior volsella length 100–125, 111; apex simple, with 2–4 sensilla chaetica in 3–4 rows, with 2–4 well developed ventral preapical setae. Anal point bare, strongly deflexed so that it often is not visible dorsally; with 0 dorsal basal setae and 11–16, 13 lateral basal setae.

FEMALE IMAGO (n = 3)

COLOR. Generally similar to male, abdomen completely dark brown. Wings duskier than in male and in some specimens with a more distinct, darker cloud over R_1, R_{4+5}, M, Cu and An.

LENGTH. Total 3.16–4.11, 3.65 mm. Thorax 1.16–1.48, 1.32 mm. Abdomen 2.00–2.63, 2.32 mm.

HEAD. Setae: temporal 38–49, 43; clypeal 16–44, 29; cibarial 9–11, 10. Palpomere lengths: 47–55, 51; 48–60, 55; 118–180, 144; 162–193, 173; 223–300, 255. Frontal tubercles 5–13, 8 long, 5–8, 7 wide. AR 0.46–0.50, 0.48.

THORAX. Scutal tubercle well to moderately developed; humeral pit a low bare area to 5 small scattered tubercles. Acrostichals 10–12, 11; dorsocentrals 16–20, 18; scutellars 10–12, 11; prealars 8–10, 8.

WING. Length 1.97–2.75, 2.41 mm; width 0.67–0.88, 0.79 mm. FCu distal to RM. VR 0.83–0.91, 0.86. Setae: brachiolum 2–3, 2; squama 11–19, 16; R 19–23, 22; R_1 16–29, 23; R_{4+5} 28–41, 36.

LEGS. Foretarsal beard absent. Palmate sensilla chaetica: 32–34, 33 on middle metatarsus; 12–23, 18 on hind metatarsus. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	910–1130, 1043	860–1100, 995	970–1200, 1080
ti	600–850, 747	780–990, 897	950–1270, 1128
ta_1	1400–1585, 1465	375–510, 453	570–765, 688
ta_2	460–590, 528	180–240, 210	290–385, 343
ta_3	375–510, 445	130–165, 142	250–320, 287
ta_4	320–390, 357	75–80, 78	135–150, 142
ta_5	170–185, 177	75–80, 77	100–110, 105
LR	1.65–2.64, 2.02	0.48–0.52, 0.50	0.60–0.63, 0.61
BV	2.20–2.34, 2.17	4.33–4.94, 4.62	3.19–3.35, 3.30
SV	0.95–1.41, 1.23	4.09–4.37, 4.19	3.06–3.37, 3.22

ABDOMEN. 3-9 ventral accessory setae on S VI. Notum 182-215, 198; cerci 100-148, 132. S VIII with 21-26, 23 setae/side; X with 6-12, 9 setae; Gc IX with 2-4, 3 setae/side. DmL, VlL and ApL as in Fig. 25G; ApL with well developed microtrichia.

PUPA: (n = 7)

COLOR. Clear with yellow-brown margins; cephalothorax light brown.

LENGTH. Total 4.26-5.28, 4.67 (3) mm. Cephalothorax 1.10-1.25, 1.17 (3) mm. Abdomen 3.10-4.03, 3.54 mm.

CEPHALOTHORAX. Cephalic tubercles well developed (Fig. 41H), 63 (2) high, 75-88 (2) wide. Dorsum moderately to well pebbled. Dc_2 closer to Dc_1 or Dc_3. Thoracic horn base (Fig. 41I) with tracheal bundles joined or narrowly separated.

ABDOMEN (Fig. 41J). Sternite I with weak posterolateral shagreen, S II-IV with very fine scattered shagreen; S V-VII with weak anterior band of shagreen; T I sometimes with very weak anterolateral shagreen areas; T II with broadly V-shaped median shagreen area with shagreen slightly larger in anterior portion; T III-V with median quadrilateral shagreen areas, T III-IV shagreen areas with anterior band of well developed spines, T V shagreen with median area of stronger spines; T VII with an anterior pair of suboval shagreen areas; T VIII with an anterior and posterior pair of ovoid or elongate fine shagreen areas. Posterior margin of T II with transverse row of 64-90, 75 hooklets. A weak reticulate cuticular pattern present on posterior portions of T VII-VIII. T VIII with 5 lateral setae. Caudolateral spurs on T VIII (Figs. 41K, L, M) 1-4, small to well developed, often with smaller basal spurs. Anal lobes with 42-69, 59 (6) setae. DR 1.83-3.05, 2.46 (6).

FOURTH INSTAR LARVA: (n = 6)

COLOR. Head capsule light brown, postmentum slightly darker.

HEAD. Postmentum length 225-260, 243 (5). Mandible length 195-200, 197 (4), with 3 triangular lateral teeth, a depression proximal to 3rd tooth; two well developed dorsal teeth present. Pecten mandibularis composed of 8-9, 9 setae. Mentum (Fig. 41N) with 13 teeth, 6th lateral tooth broadly rounded, 5th reduced; width 123-153, 139 (5); MR 2.14-2.53, 2.39 (4). Ventromental plate with smooth anterior margin; width 85-106, 96; length 47-58, 53. VPR 1.73-1.88, 1.81; IPD 47-55, 51 (4); PSR 1.96-2.04, 2.01 (4); 30-34, 32 strial ridges. Length of antennal segments: 55-74, 67 (5); 20-33, 24 (5); 7-10, 9 (4); 11-13, 12 (4); 5-6, 6 (4). AR 0.90-1.51, 1.32 (4) (Fig. 41 O). Inner blade of premandible subequal to outer blade. Pecten epipharyngis (Fig. 41P) with 4-5, 5 lobes. Frontal apotome (Fig. 41Q) with large dorsal anteromesal ovoid depression, labral sclerite 1 smooth. S I with 6-8, 7 fringes.

BODY. Ventral tubuli absent.

REMARKS. A widespread species throughout the Oriental-Australasian areas. The distinctive hypopygium is very similar to that of the Afrotropical *D. kribiicola* (Kieffer); the immature stages of the 2 species differ sufficiently to maintain the 2 as separate species.

I have examined the type series of *Tendipes pelochloris,* housed in the IP. It consisted of 3 pinned specimens, apparently the 2 males and 1 female listed at the end of Kieffer's (1912) description. Because no holotype was designated, the 3 specimens must be considered syntypes. The specimens bear "type" labels that were obviously added at a later date (a viewpoint agreed to by Dr. H.J. Müller, director of the IP, in a personal communication, 23-III-1987). Two specimens bear "cotypus" and "paratypus" labels, the other specimen bears a "typus" and "holotypus" label. None of

these designations are valid, because holotypes and paratypes can only be fixed by the author in the original publication (International Code of Zoological Nomenclature, Chapter XVI (1985)).

I am designating as lectotype a male specimen, remounted on a microscope slide in Canada balsam, which bears the following labels: "LECTOTYPE, Tendipes pelochloris Kieffer, 1912/ J.H. Epler 1987/ Paratypus/ COTYPUS (with a line drawn through the word)/ Tainan, Formosa, H. Sauter, X, 08/ Coll. DEI, Eberswalde/ 87-1" (my personal identification number used in slide preparation) and my determination label. I have designated the other 2 specimens, a male and female, both still pinned, as paralectotypes. The male paralectotype consists only of a head (without antennae), thorax and a wing; it bears the following labels: "Tainan, Formosa, H. Sauter, X, 08/ Tendipes pelochloris (in Kieffer's handwriting)/ Holotypus/ TYPUS (with a line drawn through the word)/ Coll. DEI, Eberswalde/ PARALECTOTYPE" and my determination label. The female paralectotype bears similar labels with the exceptions of paratypus and COTYPUS (with a line drawn through the word) labels, and does not bear a Kieffer determination label. A non-type female specimen is also present in the IP collection. It bears a handwritten (in Kieffer's hand) label "*Cryptochironomus pelochloris* K." The specimen is a female *D. pelochloris* and has 3 ventral accessory setae on S VI. I have remounted this specimen in balsam on a microscope slide.

There is some variation in coloration. Specimens from Japan are strikingly marked, with females possessing wings with extensive smoky-brown "clouded" areas much darker than those of the male. Specimens from Thailand (not examined for this study) were apparently green (Hashimoto, et al. 1981). Many specimens examined from Australia, such as the type series of *wirthi,* are quite dark in general body coloration, and resemble the type series of *pelochloris.* I consider *wirthi* a junior synonym of *D. pelochloris;* the immature stages are morphologically inseparable.

The holotype of *Chironomus inferior* is a female specimen in alcohol with a wing mounted on a microscope slide. The specimen is bleached and lacks foretarsi. According to Johannsen (1932:535), this specimen was reared. Lenz (1937:7) described the larva and pupa of this species, but did not state that the specimens he described were the exuviae of the holotype, or how they were associated. I have examined a single larva and a female pupal exuviae determined by Lenz as *inferior.* All the specimens were apparently collected together (code #R38, see also Remarks under *D. flexus*). I am assuming that the immature stages are those of *inferior;* these immature specimens are inseparable from *D. pelochloris* and *inferior* becomes a junior synonym of *D. pelochloris.*

I've examined a larva, pupal exuviae and an adult male of *Xenochironomus loripes* Guha et Chaudhuri (determined as "*Einfeldia loripes*" by S.K. Das). Chaudhuri & Guha (1987) later placed this species in *Einfeldia*. I consider this species to be a junior synonym of *D. pelochloris*.

I was not able to locate a type specimen of *Limnochironomus niveicaudus*. It is not present in the collection at the University of the Philippines at Los Banos (V.J. Calilung, pers. comm.), the Hungarian National Museum (L. Papp, pers. comm.), the IP (H.J. Müller, pers. comm.) or the US (R.V. Peterson, pers. comm.).

This is 1 of 2 species known to me outside of the Neotropical region in which the male bears palmate sensilla chaetica on the metatarsus of the hind leg (the other species is *D. pseudoconjunctus*). These sensilla chaetica were present on all specimens examined except the males from Japan. They were present on all females examined, including those from Japan.

MATERIAL EXAMINED: AUSTRALIA: New South Wales, Mosman, light trap, 9 March 1957, leg. W.W. Wirth, 2 males (1 male holotype *wirthi* [US]; 1 male paratype *wirthi* [BM]); same data except 12-I-1957, 2 females (paratypes *wirthi* [US]). Northern Territory: Goanna Lagoon, Gulungil Creek, Alligator Rivers region, 3-XI-1979, leg. J. Martin, 1 male/Pex, 2 males (JM). Queensland: Sarina, egg mass Y, laid about 21-I-1969, leg. J. Martin & D.L. Porter, 4 males/Pex/Lex, 2 females/Pex/Lex, 1 pharate female pupa/Lex, 1 female (laid egg mass Y), 3 larvae (JM); Somerset Dam, ca. 80 ml. N. Brisbane, 25-V-1969, leg. J. Martin, 7 males, 1 female (JM). INDIA: Tamil Nadu: before Madurai, 25-IX-1985, leg. C.W. & L.B. O'Brien, 1 male (JE). West Bengal: Kalna, Sept. 1983, leg. S.K. Das, 1 male, 4 Pex, 1 larva (UB). [INDONESIA]: [Sumatra]: Sudsumatra, heisse Quellen am Ranau-See, 40°, *Lyngbya*-Zone, 5-II-1929, leg. A. Thienemann, 1 female (holotype *Ch. inferior*) (BM), 1 female Pex, 1 larva (ZS). JAPAN: Hamamatsu and Shizuoka, Aug-Nov 1984, H. Hashimoto, 6 males, 5 females (HH). PAKISTAN: Sind: Haleji Lake (Indus Delta), 23-VIII-1985, leg. C.W. & L.B. O'Brien, 3 males (JE). PHILIPPINES: Laguna Prov., Luzon, Laguna de Bay, Los Banos, 31-V-1983, leg. J.K. Balciunas, 2 males (JB). SOUTH KOREA: leg. H.I. Ree, 2 males (det. *K. hoonsooi*) (ZS). [TAIWAN] FORMOSA: Tainan, X-[19]08, H. Sauter, 2 males, 1 female (type series *pelochloris*); Taihoku, 7-IX-1912, H. Sauter, 1 female (det. "*Cryptochironomus pelochloris* K").

Dicrotendipes pseudoconjunctus sp. nov. (Figs. 31, 39, 40)

Chironomus (*Dicrotendipes*) *conjunctus* Walker. Freeman 1961a:695 (in part).

TYPE LOCALITY: Scotts Lagoon near Lady Barron, Flinders Island, Tasmania, Australia.

TYPE MATERIAL: **Holotype:** male/Pex/Lex. [AUSTRALIA: Tasmania]: Scotts Lagoon, near Lady Barron, Flinders Island, 11-II-1976, leg. Jon Martin & B.T.O. Lee (JM). **Paratypes** (13); AUSTRALIA: South Australia: Lake Leake, via Kalangadoo, from egg mass #4, [no date], leg. J. Martin, 1 male, 1 Pex (not associated with male) (JM). Tasmania: Arthurs Lakes, 28-I-1966, leg. G.F. Edmunds, 1 male (ZS); Interlaken, Lake Sorell, 14-X-1972, leg. J. Martin, 1 male (JM); Lake Leake, 21-X-1972, leg. J. Martin, 1 male (JM); Oatlands, Lake Dulverton, 12-II-1965, 2 males (JM). Victoria: Ocean Grove, 19-VIII-1960, leg. J. Martin, 1 male (BM);

same locality & collector, 16-XII-1960, 2 males (BM); South Melbourne, vicinity of Albert Park Lake, from egg mass A, laid-XII-1967, 2 males (JM). Western Australia: Lake Monger, 18-X-1956, D.H. Edward, 1 male (BM). The holotype will be deposited in the AN, paratypes in BM, JE, JM, ZS.

DIAGNOSIS: The adult male can be distinguished from the similar *D. conjunctus* and *D. cumberlandensis* by the strongly arched, medially directed superior volsella, by its smaller (than *cumberlandensis*) inferior volsella and by the presence of acrostichal setae. The female is unknown. See diagnosis for pupa and larva under *D. conjunctus*.

ETYMOLOGY: From the Greek *pseudos,* fallacy. Refers to the confusion of this species with the similar *D. conjunctus*.

MALE IMAGO (n = 5)

COLOR (pinned specimens). Head and thorax yellow-brown, scutellum pale green to green; abdomen green, T VI-VII darker, T VIII-IX brown. Legs light brown to brown, femora lighter on approximate proximal ½, tibiae sometimes lighter medially. Wings immaculate, very light dusky brown; veins brown.

LENGTH. Total 5.46–6.85 (2) mm. Thorax 1.37–1.75, 1.52 (3) mm. Abdomen 4.03–5.10, 4.45 (4) mm.

HEAD. Setae: temporal 45–49, 47; clypeal 17–22, 20; cibarial 8–18, 12. Palpomere lengths: 50–55, 53 (3); 55–75, 63 (4); 140–180, 163 (4); 188–215, 203 (4); 273–315, 285 (4). Frontal tubercles 23–33, 27 long, 8–13, 10 wide. AR 2.50–2.56, 2.52 (3).

THORAX. Scutal tubercle moderately to well developed; humeral pit weak, scarlike or with about 5 small tubercles. Acrostichals 8–18, 12 (4); dorsocentrals 18–36, 25; scutellars 11–19, 15; prealars 9–12, 10.

WING. Length 2.38–3.40, 2.75 mm; width 0.66–0.94, 0.78 mm. FCu slightly distal to or below RM. VR 0.91–0.96, 0.93. Setae: brachiolum 3–5, 4; squama 16–25, 21; R 16–24, 22; R_1 2–18, 11; R_{4+5} 11–24, 17.

LEGS. Foretarsal beard well developed. Palmate sensilla chaetica: 9–18, 13 on middle metatarsus, 0–5, 2 (4) on hind metatarsus. Lengths and proportions of legs (4), p. 141.

ABDOMEN. 0–1 ventral accessory setae on S VI.

HYPOPYGIUM (Fig. 31D) with 9–15, 11 medial setae, set within a weakly defined ovoid area. Gonostylus broad, curved medially, with 4–5, 5 preapical setae. Superior volsella (Fig. 31E) length 80–115, 96; width 33–43, 39; LWR 1.9–2.7, 2.5; somewhat digitiform with ventral extension, strongly curved mediad; with 7–13, 10 sensilla chaetica. Inferior volsella length 150–193, 167; apex broad and notched slightly, with 1–8 sensilla chaetica in 2–4 rows, with 2–5 well developed ventral preapical setae. Anal point bare dorsally, slightly deflexed; with 0 dorsal basal setae and 16–19, 18 lateral basal setae.

PUPA: (n = 2)

COLOR. Light yellow-brown with darker borders.

LENGTH. Total 5.60–6.08 mm. Cephalothorax 1.35–1.50 mm. Abdomen 4.25–4.58 mm.

CEPHALOTHORAX. Cephalic tubercles well developed, not measurable in specimens before me. Dorsum moderately pebbled. Dc_2 closer to Dc_1 or Dc_3. Thoracic horn base (Fig. 39J) with tracheal bundles narrowly joined.

ABDOMEN (Fig. 39K). Sternites I-IV with fine medio-lateral shagreen areas; S V-VIII with anterior pair of fine shagreen areas; T I with well developed reticulate cuticular pattern; T II with median quadrilateral shagreen area, shagreen larger in posteromedial portion, and weak

	P_1	P_2	P_3
fe	950–1200, 1035	950–1180, 1019	1015–1320, 1111
ti	770–1010, 840	900–1170, 980	1155–1500, 1259
ta_1	1190–1450, 1287 (3)	470–600, 515	750–950, 830
ta_2	535–650, 588 (3)	240–320, 271	410–510, 453
ta_3	470–570, 513 (3)	190–260, 215	320–410, 353
ta_4	390–470, 427 (3)	120–170, 136	175–230, 195
ta_5	170–225, 198 (3)	100–140, 113	110–155, 129
LR	1.44–1.58, 1.52 (3)	0.51–0.54, 0.53	0.63–0.69, 0.66
BV	1.75–1.91, 1.84 (3)	3.31–3.56, 3.43	2.73–2.89, 2.83
SV	1.44–1.52, 1.47 (3)	3.80–3.97, 3.88	2.73–2.97, 2.85

pair of anterolateral shagreen areas; T III with median quadrilateral shagreen area with anterolateral extensions, shagreen larger posteromedially; T II-III also with lateral longitudinal shagreen bands; T IV-VI with median quadrilateral shagreen areas, shagreen largest posterolaterally; T VII with anterior pair of suboval shagreen areas; T VIII with an anterior and posterior pair of ovoid fine shagreen areas; shagreen areas on T IV-V with distinctive adjoining area of fine spine bands in posterior portion of area. Posterior margin of T II with transverse row of 70–80 hooklets; posterior margin of T V with 2 groups of 12–17 spines (26–31 total). A well developed reticulate cuticular pattern present on T VII-VIII. T VIII with 5 lateral setae. Caudolateral spurs on T VIII (Fig. 39L) 1–3, well developed, sinuate, often with smaller basal spurs. Anal lobes with 46–66 setae. DR 3.18–3.76.

FOURTH INSTAR LARVA: (n = 1)

COLOR. Head capsule light brown, postmentum darker.

HEAD. Postmentum length 290. Mandible length 238, with 3 triangular lateral teeth; two well developed dorsal teeth present. Pecten mandibularis composed of 15 setae. Mentum (Fig. 40K) with 13 teeth; not measurable. Ventromental plate with smooth anterior margin; width 119; length 60; VPR 1.98; 28 strial ridges. Length of antennal segments: 90; 26; 14; 18; 6. AR 1.41. Inner blade of premandible greater than outer blade. Pecten epipharyngis with 3 lobes. Frontal apotome with large anteromesal ovoid pit, labral sclerite 1 smooth. S I with 13 fringes.

BODY. Ventral tubuli absent.

REMARKS. Freeman (1961a:695) first referred to this species as a possible new species in his discussion of *D. conjunctus*. He noted that some specimens had foretarsi with beards, and some variation in the inferior volsellae. Those specimens with bearded foretarsi were *D. pseudoconjunctus*.

The superior volsellae are markedly different (much more so than any differences in the breadth of the inferior volsellae noted by Freeman, although the inferior volsella of *pseudoconjunctus* is usually narrower apically than that of *conjunctus*) in the 2 species. The superior volsella in *D. pseudoconjunctus* is usually strongly arched mediad and has a more pronounced ventral apical extension (Fig. 31). The superior volsella of *D. cumberlandensis* is intermediate between that of *D. conjunctus* and *D. pseudoconjunctus;* however, *D. cumberlandensis* is easily distinguished by the huge apex to the inferior volsella and its lack of a foretarsal beard and acrostichal setae.

I can not reliably distinguish the pupa of *D. pseudoconjunctus* from that of *D. conjunctus*. The only difference noted between the 2 species was the number of spines at the posterior margin of T V; 14–20 spines in *D. conjunctus* and 26–31 in *D. pseudoconjunctus*. I have not found the number of these spines to be a reliable character in the other species of *Dicrotendipes* which possess them, but this does not preclude the possibility that these spines are a useful character in delimiting *D. conjunctus* and *pseudoconjunctus*. This might be tested by examining a larger series of specimens, for I was limited by an extremely small sample.

The same may be true for the larvae of these 2 species which I examined. I was able to examine only 1 larva of *D. pseudoconjunctus,* but it was markedly different from the larva of *D. conjunctus*. The *D. pseudoconjunctus* larva had a low ventromental plate strial ridge count (28) compared to *D. conjunctus* (39–45, mean 42).

I have also examined a male/Pex specimen from a pool near Lake Dove, Cradle Mt. Natl. Park, Tasmania, leg. J. Martin, 18-X-1972, which may belong here. The superior volsella resembles that of *D. pseudoconjunctus,* but the pupa would fit *D. conjunctus* utilizing the intersegmental hooklet counts discussed above. Most of the setae on the foretarsi have been lost and it is not possible to discern if the specimen possessed a foretarsal beard. The specimen may be an intermediate between *D. conjunctus* and *D. pseudoconjunctus,* and may indicate that *D. pseudoconjunctus* may be a higher latitude variant of *D. conjunctus*.

Dicrotendipes sarinae sp. nov. (Figs. 34, 42)

TYPE LOCALITY: Sarina, Queensland, Australia.

TYPE MATERIAL: **Holotype:** Male, AUSTRALIA: Queensland: Sarina, [ex] egg mass Z, laid about 21-I-1969, Jon Martin & D.L. Porter (JM). **Paratypes** (6): same locality & collectors, 19-I-1969, 1 female (laid egg mass Z) (JM); same data as holotype, 1 pharate male/Pex, 4 larvae (JM). Holotype to be deposited in AN; paratypes in AN, JE.

ETYMOLOGY. Named for the type locality.

DIAGNOSIS: The adult male can be distinguished from the similar *D. jonmartini* by the smaller, digitiform superior volsella. The pupa has more T II hooklets and fewer spines on the posterior margin of T V than *jonmartini.* The larva has fewer ventromental plate striae, higher VPR and lower PSR than *jonmartini.*

MALE IMAGO (n = 2)

COLOR (slide mounted specimens). Head, thorax, abdomen and legs brown. Wings immaculate, very light dusky brown; veins yellow-brown.

LENGTH (1). Total 4.23 mm. Thorax 1.08 mm. Abdomen 3.15 mm.

HEAD. Setae: temporal 35; clypeal 12–18; cibarial 7–10. Palpomere lengths (1): 52; 63; 108; 172; 243. Frontal tubercles 5–9 long, 8 wide. AR 2.18–2.37.

THORAX. Scutal tubercle moderately developed; humeral pit well developed with 11–12 well developed, large tubercles. Acrostichals 9–11; dorsocentrals 16–18; scutellars 9–12; prealars 5–7.

WING (1). Length 1.70 mm; width 0.57 mm. FCu below RM. VR 0.95. Setae: brachiolum 2; squama 7; R 6; R_1 0; R_4+_5 1.

LEGS. Foretarsal beard very sparse. Palmate sensilla chaetica: 9–10 on middle metatarsus, 0 on hind metatarsus. Lengths and proportions of legs (1):

	P_1	P_2	P_3
fe	770	720	790
ti	570	685	850
ta_1	920	310	590
ta_2	460	180	290
ta_3	375	140	275
ta_4	280	90	150
ta_5	145	70	100
LR	1.61	0.45	0.69
BV	1.79	3.57	2.74
SV	1.46	4.53	2.78

ABDOMEN. Ventral accessory setae not apparent on S VI.

HYPOPYGIUM (Fig. 34C) with 6–8 dorsomedial setae. Gonostylus broad, almost straight medially, with 4 preapical setae. Superior volsella (Fig. 34D) length 40–43; width 15–18; LWR 2.4–2.7; digitiform, slightly curved mediad; with 4–5 sensilla chaetica. Inferior volsella with membranous dorsal extension, with 1–3 sensilla chaetica on or near extension; length 75–100; apex clubbed, with 1–3 sensilla chaetica in 2 rows, with 2 well developed ventral preapical setae. Anal point bare dorsally, slightly deflexed; with 8–12 lateral basal setae.

FEMALE IMAGO (n = 1)

COLOR. Similar to male.

LENGTH. Total about 3.78 mm. Thorax 1.05 mm. Abdomen about 2.13 mm.

HEAD. Setae: temporal 34; clypeal 23; cibarial 13. Palpomere lengths: 55, 70; 135; 175; 260. Frontal tubercles 5 long, 8 wide. AR 0.46.

THORAX. Scutal tubercle well developed; humeral pit well developed with about 12 well developed tubercles. Acrostichals 7; dorsocentrals 25; scutellars 15; prealars 9.

WING. Length 1.56 mm; width 0.59 mm. FCu below RM. VR 0.87. Setae: brachiolum 2; squama 9; R 19; R_1 13; R_{4+5} 18.

LEGS. Foretarsal beard absent. Palmate sensilla chaetica: 52 on middle metatarsus; 0 on hind metatarsus. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	779	710	770
ti	545	650	805
ta_1	870	300	530
ta_2	360	150	530
ta_3	305	100	—
ta_4	245	75	—
ta_5	135	70	80
LR	1.60	0.46	0.66
BV	2.09	4.20	—
SV	1.51	4.53	2.97

ABDOMEN. Ventral accessory setae not apparent on S VI. Notum 172; cerci 93. X with 10 setae; Gc IX with 1 seta/side.

PUPA: (n = 1)

COLOR. Light yellow-brown.

LENGTH. Not measurable.

CEPHALOTHORAX. Cephalic tubercles well developed, about 43 high, 75 wide. Dorsum moderately pebbled. Dc_2 closer to Dc_3. Thoracic horn base with tracheal bundles separated.

ABDOMEN. Damaged, but shagreen appears to be similar to *D. jonmartini* (Fig. 42B). Posterior margin of T II with transverse row of 95 hooklets. Posterior margin of T V with about 20 spines, apparently in single row. T VIII with 5 lateral setae. Caudolateral spurs on T VIII similar to *jonmartini* (Figs. 42C, D). Anal lobes with 32 setae. DR not measurable.

FOURTH INSTAR LARVA: (n = 3)

COLOR. Head capsule light brown, integument with grainy appearance.

HEAD. Postmentum length 193–205, 198. Mandible length 158–175, 165, with 3 triangular lateral teeth; two well developed dorsal teeth present. Pecten mandibularis composed of 9–10, 10 setae. Mentum (Fig. 42H) with 13 teeth; width 115–125; MR 2.88–2.98 (2). Ventromental plate with smooth anterior margin; width 85–92, 88 (4); length 47–50, 49; VPR 1.76–1.84, 1.80; IPD 35–41, 37; PSR 2.24–2.46, 2.38; 28–30, 29 (4) strial ridges. Length of antennal segments (4): 28–30, 29; 52–57, 55; 15–17, 16; 10–11, 10; 12–14, 13. AR 1.15–1.33 (Fig. 42I). Inner blade of premandible subequal to outer blade. Pecten epipharyngis with 3–4, 3 (4) lobes (Fig. 42J). Frontal apotome with weak elongate-oval frontal pit; labral sclerite 1 smooth. S I with 6–11, 8 fringes (Fig. 42K).

BODY. Ventral tubuli absent.

Dicrotendipes semiviridis (Kieffer)

Chironomus semiviridis Kieffer, 1911a:166; Johannsen 1932:532.
Dicrotendipes semiviridis (Kieffer): Sublette & Sublette 1973:404; Chaudhuri & Guha 1987:27.

I have seen only 1 specimen of this species, a female syntype from the Brunetti collection in the BM. The female (a pinned specimen) is a washed out yellow-green with no distinguishing marks; it appears to be a *Dicrotendipes*. There are no ventral accessory setae apparent on S VI.

Kieffer's figure (1911a:Fig. 24) and description contribute little to the identification of this species. According to Kieffer (1911a:111), the specimens he described in his 1911 paper were kept at the Indian Museum of Calcutta. These specimens are now apparently with the Zoological Survey of India, Calcutta. According to M. Datta, Zoological Survey of India (pers. comm., 12-XI-1986) specimens of *semiviridis* are in their collection, but "are in extremely miserable condition and are suggestive of not being mailed to anybody so as to save from further deterioration." Until the male of this species is redescribed (and because the female offers no specific characters), I consider *D. semiviridis* a *species inquirenda*.

MATERIAL EXAMINED: BURMA: Mandalay, 11-III-1908, N. Annandale, ex Brunetti coll., 1 female (syntype *semiviridis*) (BM).

Dicrotendipes septemmaculatus (Becker)

See description and remarks in Chapter II.

Dicrotendipes taylori (Freeman)

Chironomus (*Dicrotendipes*) *taylori* Freeman, 1961a:692.

See adult description in Freeman (1961a:692); the immature stages are unknown.

MATERIAL EXAMINED: AUSTRALIA: Queensland: Innisfail, [no date], F.H. Taylor, 2 males (holotype [SP]; paratype [BM]).

Dicrotendipes tenuiforceps (Kieffer) (Figs. 37, 51)

Tendipes tenuiforceps Kieffer, 1913a:136.
Chironomus (*Dicrotendipes*) *innisfailensis* Freeman, 1961a:694. **NEW SYNONYMY.**
Dicrotendipes tenuiforceps (Kieffer): Sublette & Sublette 1973:404; Chaudhuri & Guha 1987:27.

DIAGNOSIS: The adult male can be distinguished by its distinctive superior volsella. The immature stages are unknown.

MALE IMAGO (n = 2)

COLOR (pinned specimens). Head light brown, thorax golden yellow to orangish-yellow, abdomen yellow-orange to light green; legs greenish-stramineous, fore tibia light brown. Wings immaculate, clear; veins yellow-brown.

LENGTH. Total about 3.80 (1) mm. Thorax 0.78–1.10 mm. Abdomen about 2.70 mm.

HEAD. Setae: temporal 22–46; clypeal 10–16; cibarial 7. Palpomeres not measurable. Frontal tubercles 5–12 long, 5–7 wide. AR 2.03–2.33.

THORAX. Scutal tubercle well developed; humeral pit a scar or with 3–5 small tubercles. Acrostichals 6–12; dorsocentrals 11–12; scutellars 6–9; prealars 6–10.

WING. Length 1.48–1.63 mm; width 0.42–0.48 mm. FCu distal to RM. VR 0.85–0.86. Setae: brachiolum 2; squama 1–4; R 9–16; R_1 0–3; R_{4+5} 1.

LEGS. Foretarsal beard absent. Palmate sensilla chaetica: 5 (1) on middle metatarsus, 0 (1) on hind metatarsus. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	730–920	590–750	700–870
ti	430–610	510–625	740–920
ta_1	910 (1)	285 (1)	470 (1)
ta_2	430 (1)	145 (1)	230 (1)
ta_3	395 (1)	90 (1)	200 (1)
ta_4	310 (1)	49 (1)	110 (1)
ta_5	145 (1)	45 (1)	60 (1)
LR	2.12 (1)	0.56 (1)	0.64 (1)
BV	1.62 (1)	4.33 (1)	3.18 (1)
SV	1.27 (1)	3.86 (1)	3.06 (1)

ABDOMEN. Flattened setae not apparent on S VI.

HYPOPYGIUM (Fig. 37A). Gonostylus thin, curved medially, with 5–7 preapical setae. Superior volsella (Fig. 37B) length 63–75; width 35–50; LWR 1.5–1.8; pediform-clubbed, apex directed laterad, with 5–8 sensilla chaetica. Inferior volsella length 112–115; apex simply clubbed; with 3–4 sensilla chaetica in 2 rows, with 1 well developed ventral preapical seta. Anal point bare dorsally, slightly deflexed; with 7 dorsal basal setae and 7–8 lateral basal setae.

REMARKS. Although not labeled as such, the single male specimen from the Brunetti collection in the BM may have type status. Kieffer's material for his 1913 paper was apparently kept at the Indian Museum of Calcutta and may now be with the Zoological Survey of India, Calcutta. I interpret a recent letter from M. Datta (with the Zoological Survey of India) as stating that no material of *tenuiforceps* is present in their collection. The Brunetti specimen was collected at Calcutta in September, which is in the range of dates Kieffer lists at the end of his description, and may be one of the original specimens described. Before any type status can be

inferred to this specimen, the collection at the Zoological Survey of India must be inspected in situ by a competent chironomid worker.

Freeman's *innisfailensis* (Freeman 1961a) is clearly a junior synonym of *tenuiforceps*, as evidenced by the distinctive hypopygium, and my examination of the holotype of *Ch. innisfailensis*.

MATERIAL EXAMINED: [AUSTRALIA]: Queensland: Innisfail, [no date], F.H. Taylor, 1 male (holotype *Ch. innisfailensis*) (SP). INDIA: Calcutta, 12-IX-1907, ex Brunetti coll., 1 male (BM).

FIG. 28. *D. balciunasi,* adult male. A) Hypopygium, dorsal/ventral. B) Hypopygium, lateral. C) Median and superior volsella, dorsal.

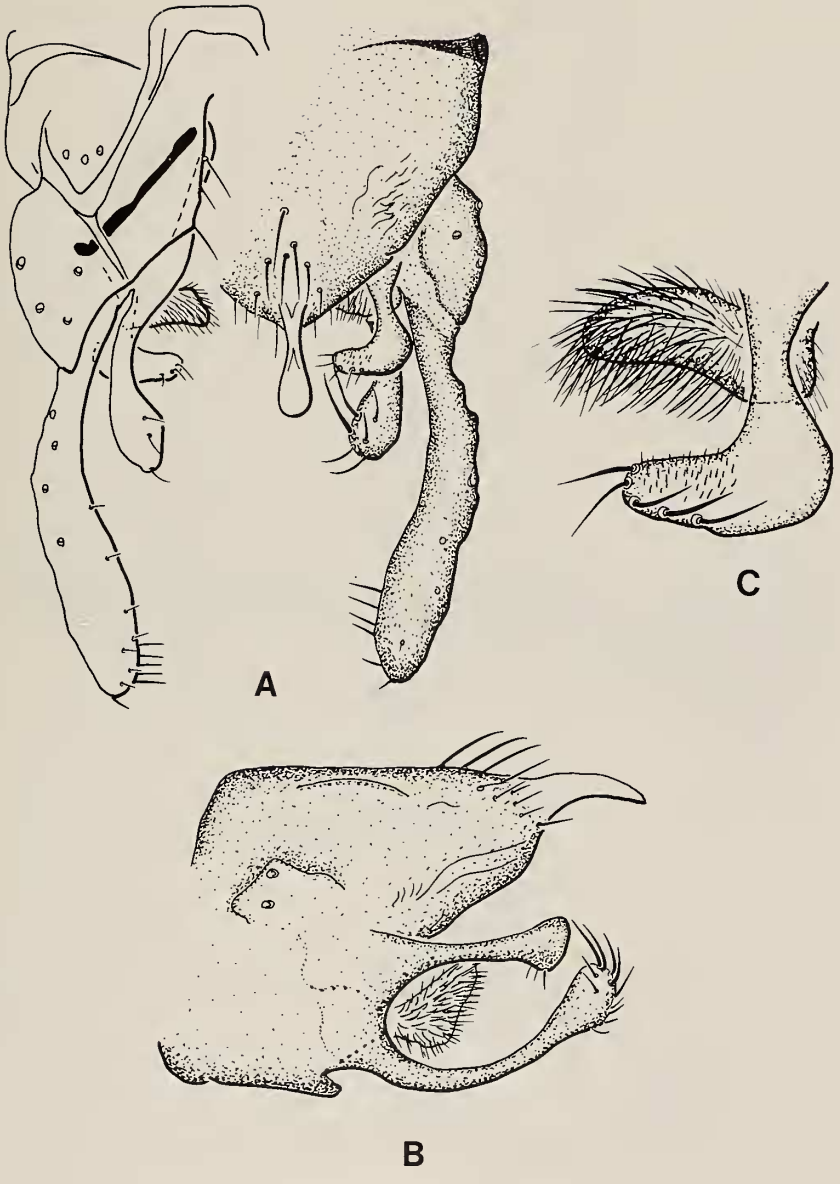

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FIG. 29. *D. bilobatus,* adult male. A) Hypopygium, dorsal/ventral. B) Hypopygium, lateral. C) Superior volsella, ventral.

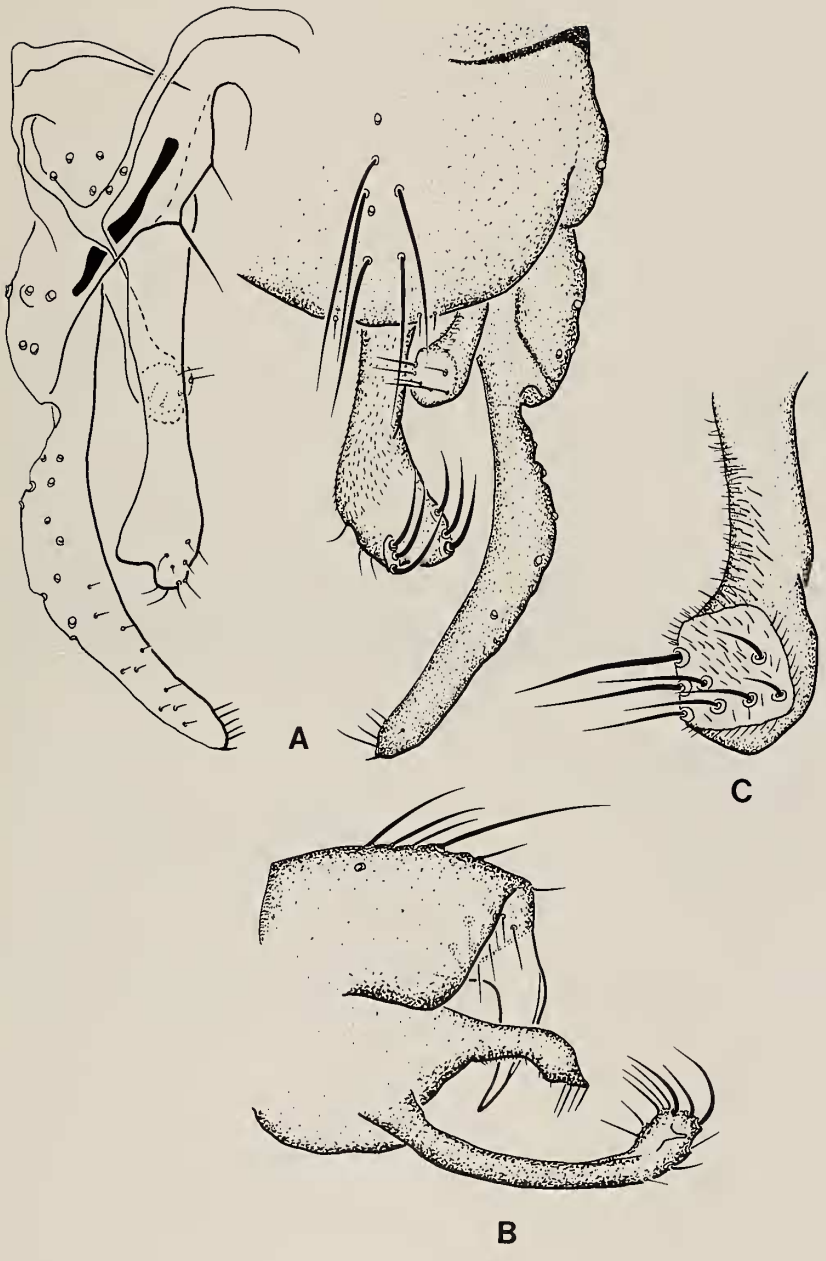
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FIG. 30. *D. candidibasis,* adult male and female. A) Hypopygium, dorsal/ventral. B) Hypopygium, lateral. C) Superior volsella, ventral. D) Superior volsella, ventral, holotype. E) Female ApL.

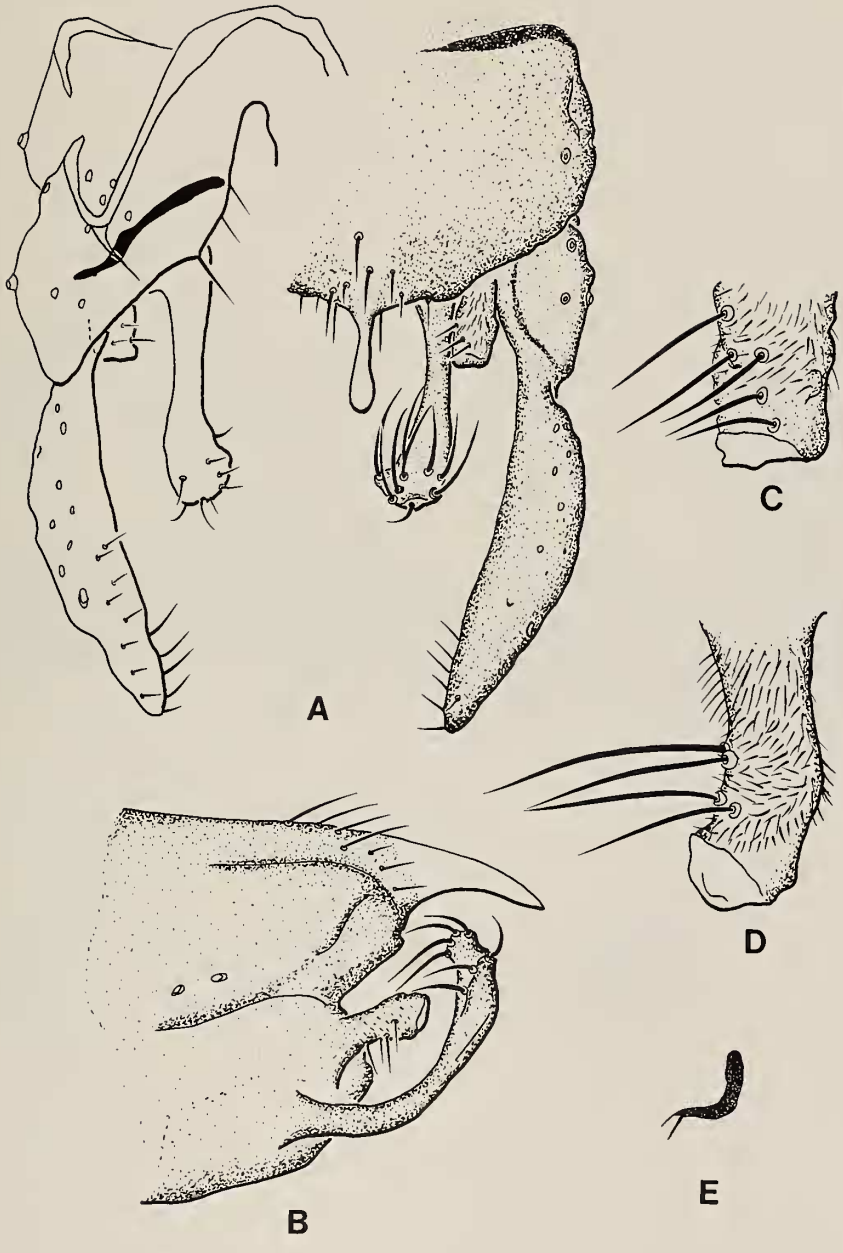
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FIG. 31. *D. conjunctus,* adult male (A-C). A) Hypopygium dorsal/ventral, lectotype. B) Superior volsella, ventral. C) Superior volsella, ventral, lectotype. *D. pseudoconjunctus,* adult male (D, E). D) Hypopygium, dorsal/ventral. E) Superior volsella, ventral.

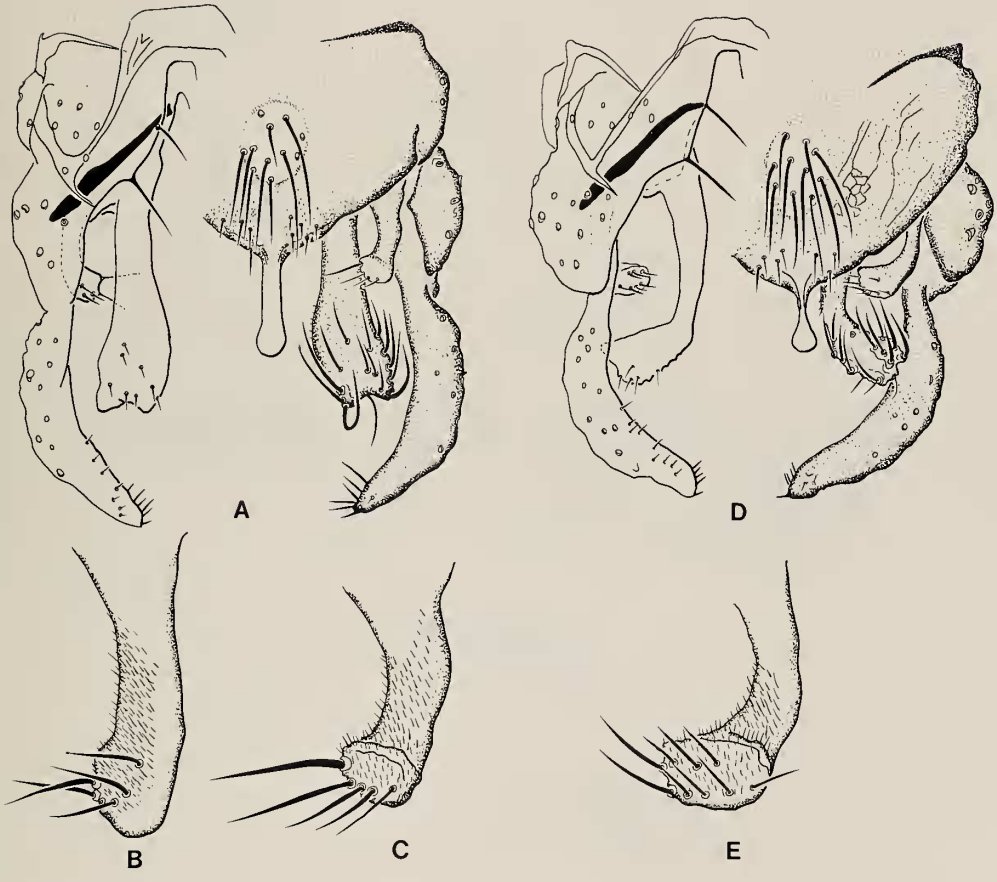
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FIG. 32. *D. cumberlandensis,* adult male. A) Hypopygium, dorsal/ventral. B) Hypopygium, lateral. C) Superior volsella, ventral.

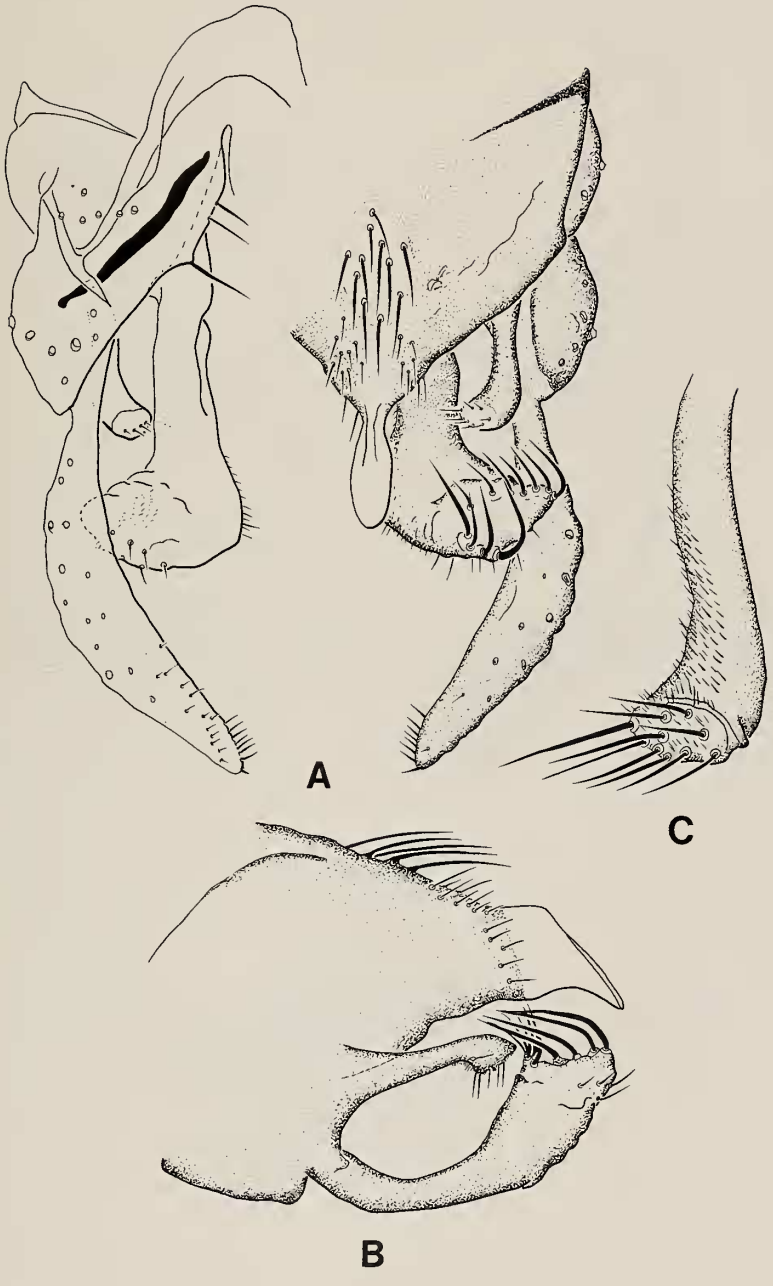
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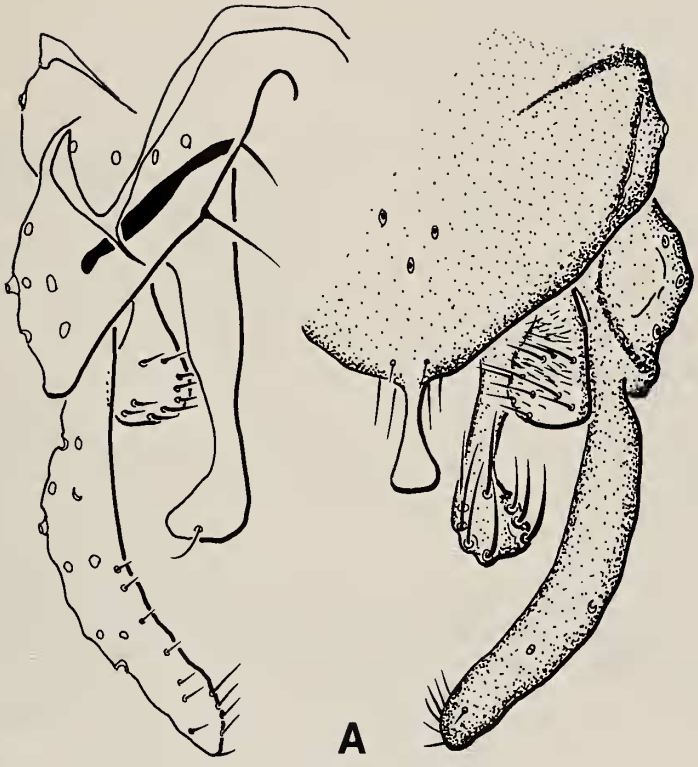
FIG. 33. *D. jobetus,* adult male. A) Hypopygium, dorsal/ventral. B) Superior volsella, ventral.



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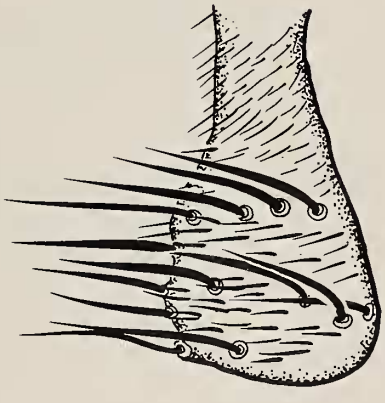

B

FIG. 34. *D. jonmartini,* adult male (A, B). A) Hypopygium, dorsal/ventral. B) Superior volsella, ventral. *D. sarinae,* adult male (C, D). C) Hypopygium, dorsal/ventral. D) Superior volsella, ventral.

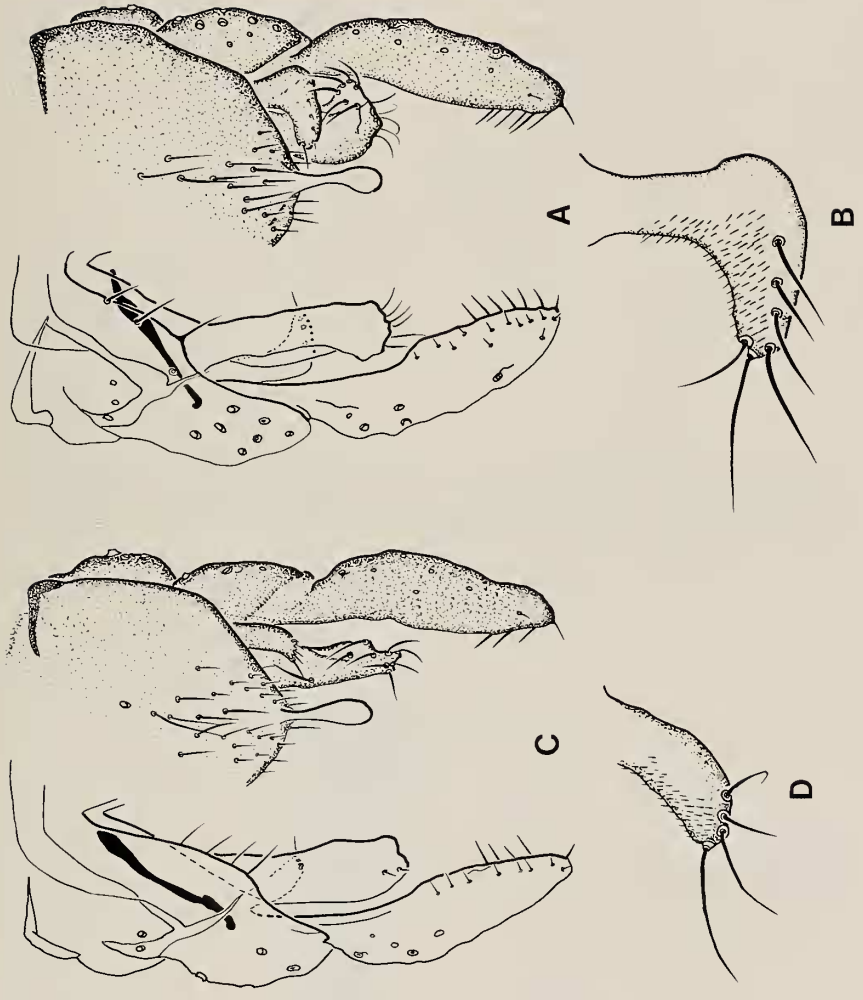
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FIG. 35. *D. lindae,* adult male. A) Hypopygium, dorsal/ventral. B) Median and superior volsella, ventral.

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B

FIG. 36. *D. pelochloris,* adult male and female. A) Hypopygium, dorsal/ventral. B) Anal point variation. C) Anal point, lateral. D) Superior volsella, ventral, Australia. E) Superior volsella, ventral, Pakistan. F) Superior volsella, ventral, Japan. G) Female DmL, ApL, VlL.

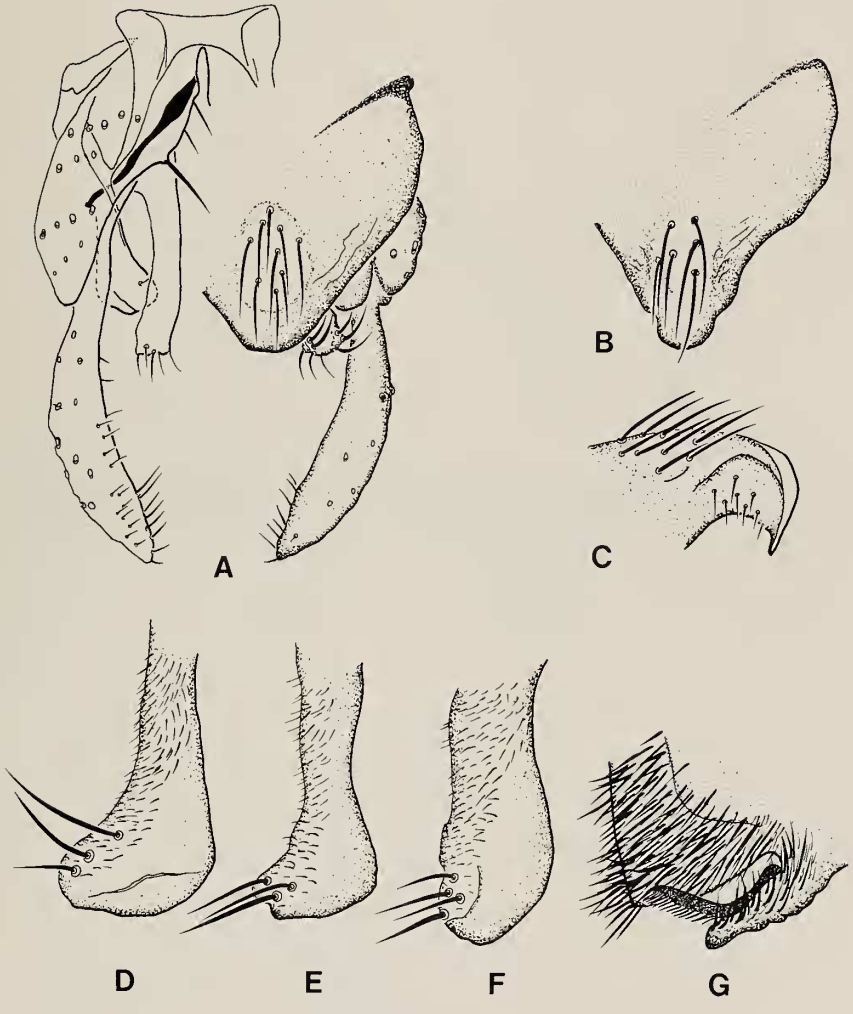
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FIG. 37. *D. tenuiforceps,* adult male. A) Hypopygium, dorsal/ventral. B) Superior volsella, ventral.

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FIG. 38. *D. candidibasis,* pupa (A-E) and larva (F-L). A) Cephalic tubercle. B) Thoracic horn base. C) Abdomen, dorsal. D, E) Caudolateral spurs on T VIII. F) Mandible, ventral. G) Mentum and ventromental plate. H) Antenna. I) Premandible. J) Pecten epipharyngis. K) Anterior portion of frontal apotome and labral sclerites. L) SI.

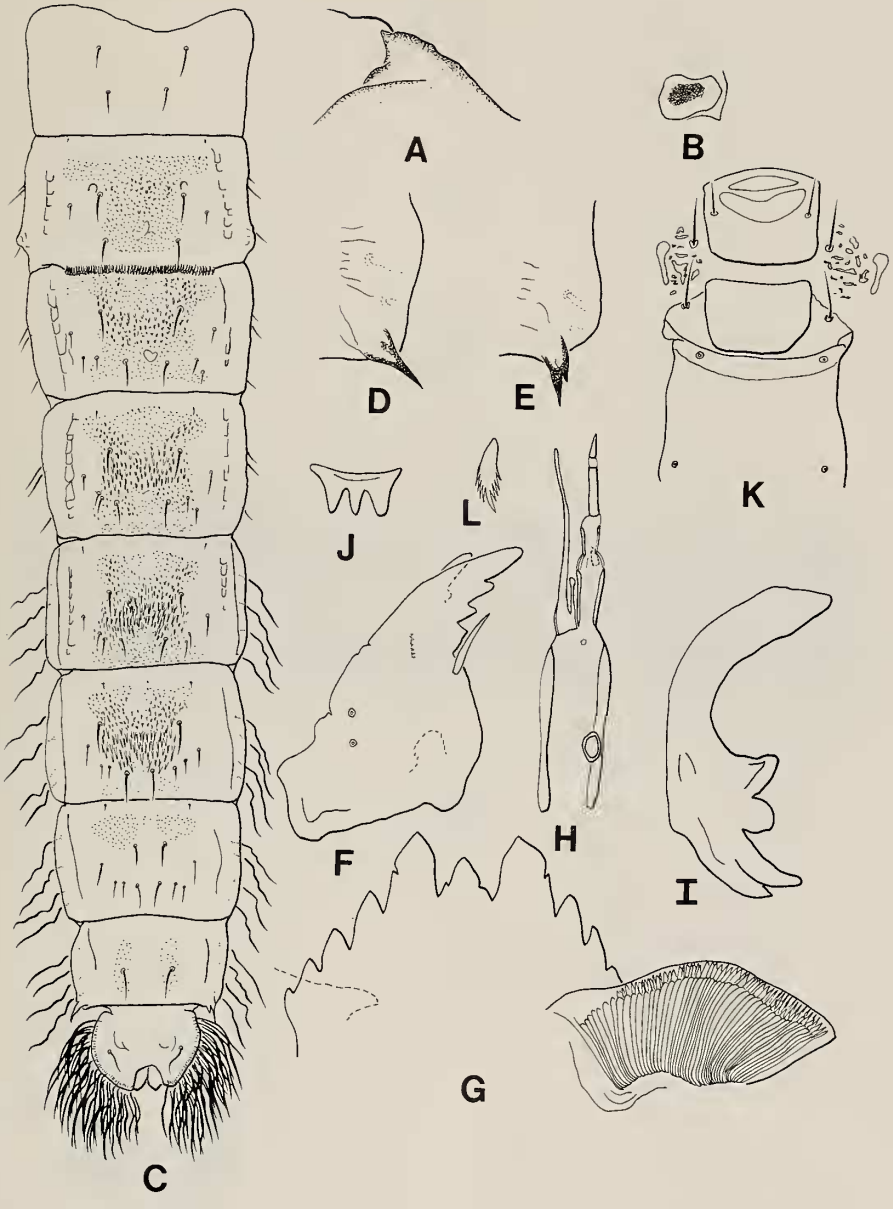
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FIG. 39. *D. conjunctus*, pupa (A, B). A) Cephalic tubercle. B) Caudolateral spurs on T VIII. *D. cumberlandensis,* pupa (C-I). C) Cephalic tubercle. D) Cephalothorax, lateral. E, F) Thoracic horn bases, showing variation. G) Abdominal tergites II-VIII, dorsal. H, I) Caudolateral spurs on T VIII. *D. pseudoconjunctus,* pupa (J-L). J) Thoracic horn base. K) Abdomen, dorsal. L) Caudolateral spurs on T VIII.


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FIG. 40. *D. conjunctus,* larva (A-E). A) Mandible, ventral. B) Mentum and ventromental plate. C) Antenna. D) Pecten epipharyngis. E) Anterior portion of frontal apotome and labral sclerites. *D. cumberlandensis,* larva (F-J). F) Mentum and ventromental plate. G) Antenna. H) Pecten epipharyngis. I) Anterior margin of frontal apotome and labral sclerites. J) SI. *D. pseudoconjunctus* larva. K) Mentum and ventromental plate.

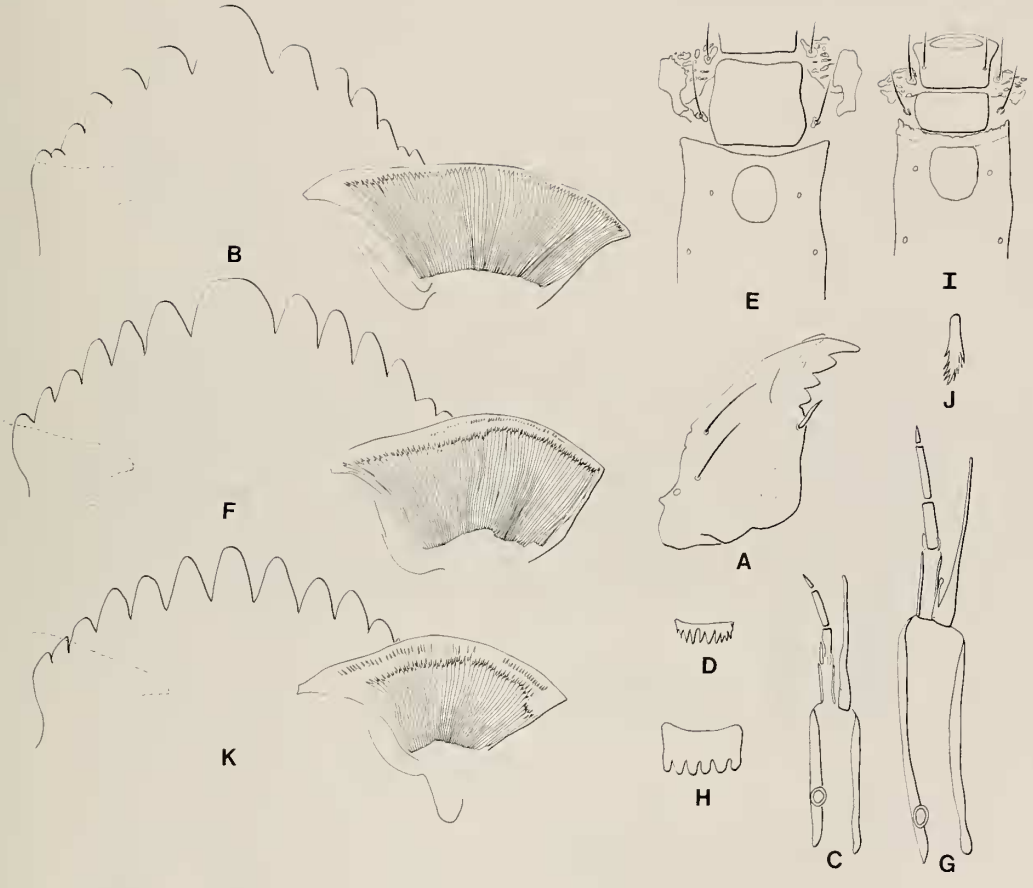
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FIG. 41. *D. flexus,* pupa (A–C) and larva (D-G). A) Thoracic horn base. B) Abdomen, dorsal. C) Caudolateral spur on T VIII. D) Mentum and ventromental plate. E) Antenna. F) Pecten epipharyngis. G) Anterior portion of frontal apotome and labral sclerites. *D. pelochloris,* pupa (H-M) and larva (N-Q). H) Cephalic tubercle. I) Thoracic horn base. J) Abdomen, dorsal. K-M) Caudolateral spurs on T VIII. N) Mentum and ventromental plate. O) Antenna. P) Pecten epipharyngis. Q) Anterior portion of frontal apotome and labral sclerites.

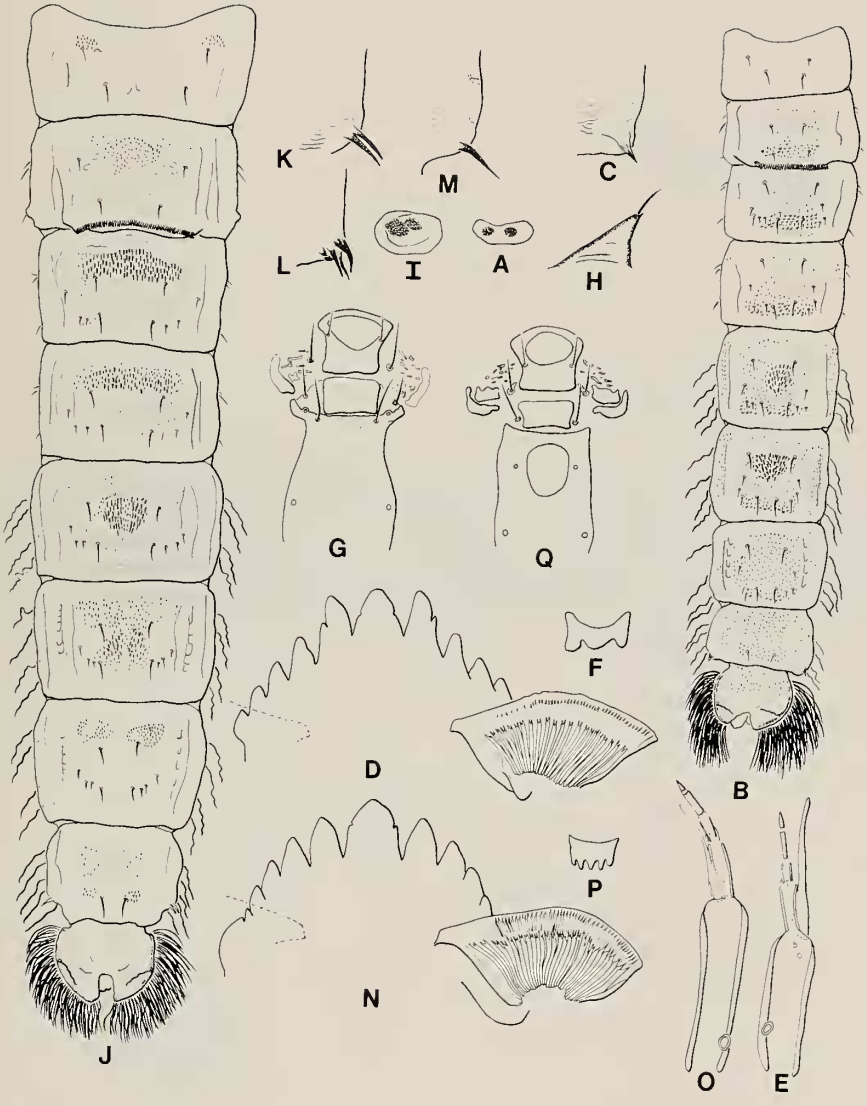
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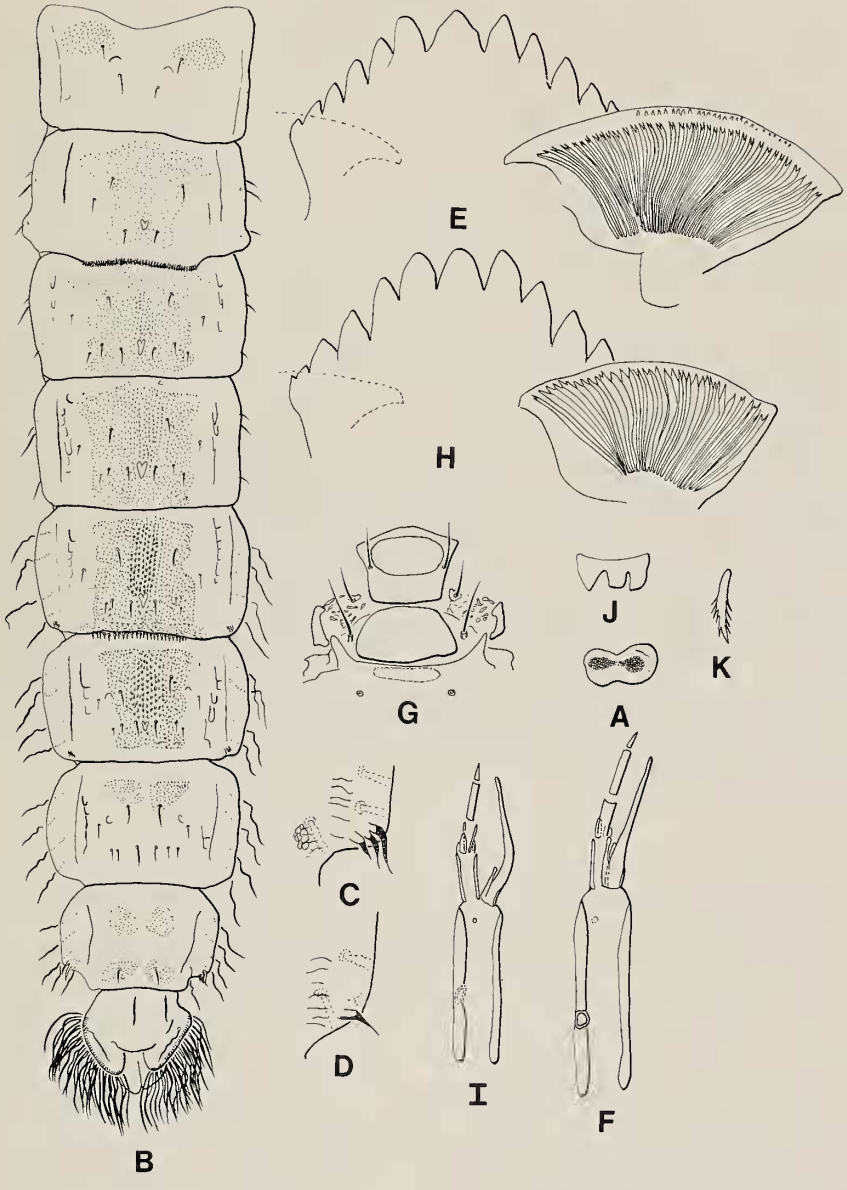
FIG. 42. *D. jonmartini,* pupa (A–D) and larva (E-G). A) Thoracic horn base. B) Abdomen, dorsal. C, D) Caudolateral spurs on T VIII. E) Mentum and ventromental plate. F) Antenna. G) Anterior margin of frontal apotome and labral sclerites. *D. sarinae,* larva (H-K). H) Mentum and ventromental plate. I) Antenna. J) Pecten epipharyngis. K) SI.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Chapter V. Zoogeography

Chironomidae are well known for their usefulness in biogeographic studies. Brundin's (1966) classic work demonstrated the hypothesized break up of Gondwanaland with the present day distribution of podonomine chironomids. However, many other groups of chironomids, including *Dicrotendipes,* apparently do not lend themselves well to historical biogeographic work (see Ashe et al. 1987). Brundin (1966) worked mainly with chironomids in the plesiomorphic subfamily Podonominae (the bulk of his 1966 monograph is a taxonomic study on the subfamily); most of the species studied are essentially cold stenotherms restricted to swiftly flowing mountain streams. In contrast, *Dicrotendipes* is cosmopolitan, vagile and inhabits many types of aquatic environments including swiftly flowing streams, ponds, and lakes, and at least 3 species inhabit brackish water salt marshes (Epler 1987a, Hashimoto 1984, Prat 1981). The present day distribution of *Dicrotendipes* shows no correlation with any tectonic movements.

Fossils may sometimes provide clues to a taxon's biogeographic history (Brown & Gibson 1983:249). Although the fossil history of the Chironomidae extends at least to the middle Jurassic to late Cretaceous (summarized by Oliver 1981; see also Ashe et al. 1987), the earliest records of *Dicrotendipes* date only from the late Pleistocene (approximately 10–12,000 years b.p.) (Hofmann 1971a, 1971b, 1978), long after any hypothesized major plate movements. A larval mentum with ventromental plates illustrated by Hofmann (1971b:fig. 19) appears to be a *D. modestus* or *D. tritomus.* Thus the fossil record to date provides no indication of the historical biogeography of the genus.

Distribution Patterns

There are some interesting distribution patterns in the genus, which are summarized and illustrated in the remainder of this chapter. Several papers have been published which deal with distribution patterns in the Chironomidae (Ashe et al. 1987; Fittkau 1980; Fittkau & Reiss 1978, 1979; Reiss 1977b, 1978; Reiss and Sublette 1985). Distribution records recorded in this chapter are taken from these papers, specimens examined for this study, papers with new distribution records (Hashimoto et al. 1981; Reiss 1986; Sasa & Hasegawa 1983) and previous revisions/descriptions (Contreras-Lichtenberg 1986; Epler 1987a, 1987b; Freeman 1957, 1961a).

I am utilizing the faunal regions as delimited in Pielou (1979:8), except that I use Afrotropical instead of Ethiopian (following Freeman & Cranston 1980 and Ashe et al. 1987).

Holarctic. Four species display a Holarctic distribution: *D. lobiger* (Fig. 43), *D. modestus* (Fig. 44), *D. nervosus* (Fig. 45) and *D. tritomus* (Fig. 46).

Pan-American. The *D. californicus* complex (*D. californicus, D. crypticus, D. embalsensis, D. obrienorum & D. pellegriniensis*) shows a western pan-American distribution pattern (Fig. 47). Some other chironomid species have a distinct pan-American distribution, i.e., *Goeldichironomus holoprasinus* (Goeldi), *G. amazonicus* (Fittkau), *G. carus* (Townes) and *Caladomyia* spp. (Reiss & Sublette 1985). If I am correct in my determination of a solitary larva from Paraguay as *D. crypticus* (see Chapter III, the specimen may be a *D. embalsensis*), this species displays an interesting disjunct distribution (Fig. 47). This distribution, as well as the apparent restriction of *D. californicus* to the west of the Andes (*D. pellegriniensis* may be a form of *D. californicus;* see Chapter III), may merely represent the relatively meager amount of chironomid collecting done in the Neotropics outside of the Amazon region. See also remarks under each species of the *D. californicus* complex in Chapter III.

Dicrotendipes aethiops has a southwestern U.S.-Mexican distribution, but apparently does not occur in the Neotropical region; *D. sinoposus* occurs in Mexico, northern South America and the Caribbean (Dominica), but does not occur in the Nearctic region (Fig. 48).

Palaearctic-Afrotropical. Several species are found in both of these biogeographic regions: *D. septemmaculatus* (Fig. 49), *D. fusconotatus* (Reiss 1977b; Contreras-Lichtenberg 1986) and *D. peringueyanus* (Prat 1981; Contreras-Lichtenberg 1986).

Pan-Palaeotropical. *Dicrotendipes septemmaculatus* (Fig. 49) is found throughout the tropics of the Old World, extends to southern Europe and Japan to the north, and is also found in north and south Australia. Along with *D. modestus* and *D. nervosus,* it is among the most widely distributed species of the genus in the world.

Species with deeply bifid inferior volsellae are distributed pantropically. However, I believe the Neotropical species with bifid inferior volsellae represent a different lineage, probably apomorphic, from the Afrotropical species with similar inferior volsellae. Until associated larvae of the Neotropical species are examined, such a hypothesis must remain a conjecture. Neotropical adults (with bifid inferior volsellae) all possess palmate sensilla chaetica on the hind metatarsus (absent on Afrotropical species). The pupae of the only 2 Neotropical species possessing bifid inferior volsellae with known pupae have 4 lateral lamellar setae on T VIII (5 in Afrotropical species) and lack anal lobe shagreen (present on Afrotropical forms). At least 2 hypotheses may explain the occurrence in the Neotropics of *Dicrotendipes* with deeply bifid inferior volsellae: 1) a vicariance hypothesis in

which the Neotropical lineage is directly descended from the Afrotropical linege; after the separation of South America and Africa (there are no data which would indicate that the genus *Dicrotendipes* had yet evolved at this period of time) the lineage evolved to the apparent apomorphic state of 4 lateral setae on pupal T VIII and a reversal occurred with the palmate sensilla chaetica on the hind metatarsus; 2) a dispersal hypothesis in which the Neotropical lineage is descended from a more apomorphic Nearctic lineage which dispersed south and then developed the palmate sensilla chaetica on the hind metatarsus. Perhaps some environmental factor in the tropics influences the genome to produce a phenotype with deeply bifid inferior volsellae. More larvae and pupae, currently unknown, of other species from the neotropics must be examined to test these hypotheses. The V-shaped median shagreen area on pupal T VI of *D. fittkaui* and *D. soccus* may ally these 2 Neotropical species with deeply bifid inferior volsellae with the Holarctic *D. nervosus* group. Such an alliance would provide support for the dispersal hypothesis concerning the distribution of species with deeply bifid inferior volsellae.

Oriental-Australasian. In addition to the afore-mentioned *D. septemmaculatus,* 3 other species range across these 2 faunal regions: *D. pelochloris* (Fig. 50), *D. flexus* (Fig. 51) and *D. tenuiforceps* (Fig. 51).

Endemics

Many species are apparently endemic to their regions. These are [(?) indicates a questionable species name]:

Nearctic: *D. adnilus, D. aethiops, D. botaurus, D. fumidus, D. leucoscelis, D. lobus, D. lucifer, D. neomodestus, D. simpsoni, D. thanatogratus* (the last species apparently endemic to Florida).

Neotropical: *D. alsinensis, D. amazonicus, D. dasylabidus, D. demissus, D. embalsensis, D. fittkaui, D. nestori, D. palearivillosus, D. paradasylabidus, D. paterjohni, D. pellegriniensis, D. radinovskyi, D. reissi, D. sinoposus, D. soccus.*

Palaearctic: *D. fusciforceps* (?), *D. inouei, D. notatus, D. pallidicornis, D. tamaviridis, D. truncatus* (?), *D. venetus* (?).

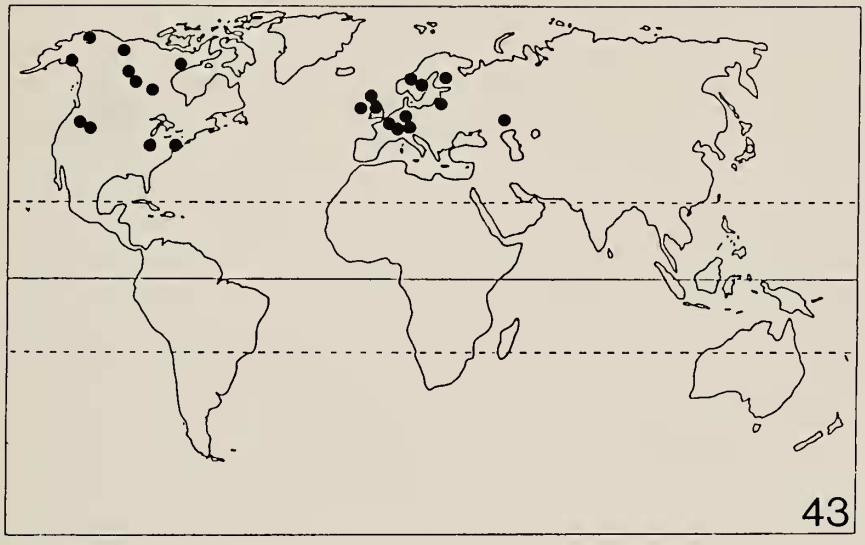
Afrotropical: *D. bredoi, D. chambiensis, D. collarti, D. cordatus, D. ealae, D. freemani, D. kribiicola, D. leucolabis, D. schoutedeni, D. sudanicus.*

Oriental: *D. arcistylus, D. canitibialis, D. semiviridis* (?).

Oceanian: *D. candidibasis.*

Australasian: *D. balciunasi, D. bilobatus, D. conjunctus, D. cumberlandensis, D. jobetus, D. jonmartini, D. leei, D. lindae, D. pseudoconjunctus, D. sarinae, D. taylori.*

Fig. 43: Distribution map for *D. lobiger.*
Fig. 44: Distribution map for *D. modestus.*


43


44

Fig. 45: Distribution map for *D. nervosus.*
Fig. 46: Distribution map for *D. tritomus.*


45


46

Fig. 47: Distribution map for *D. californicus* (●), *D. crypticus* (▲), *D. embalsensis* (*), *D. obrienorum* (◥) and *D. pellegriniensis.* (○).

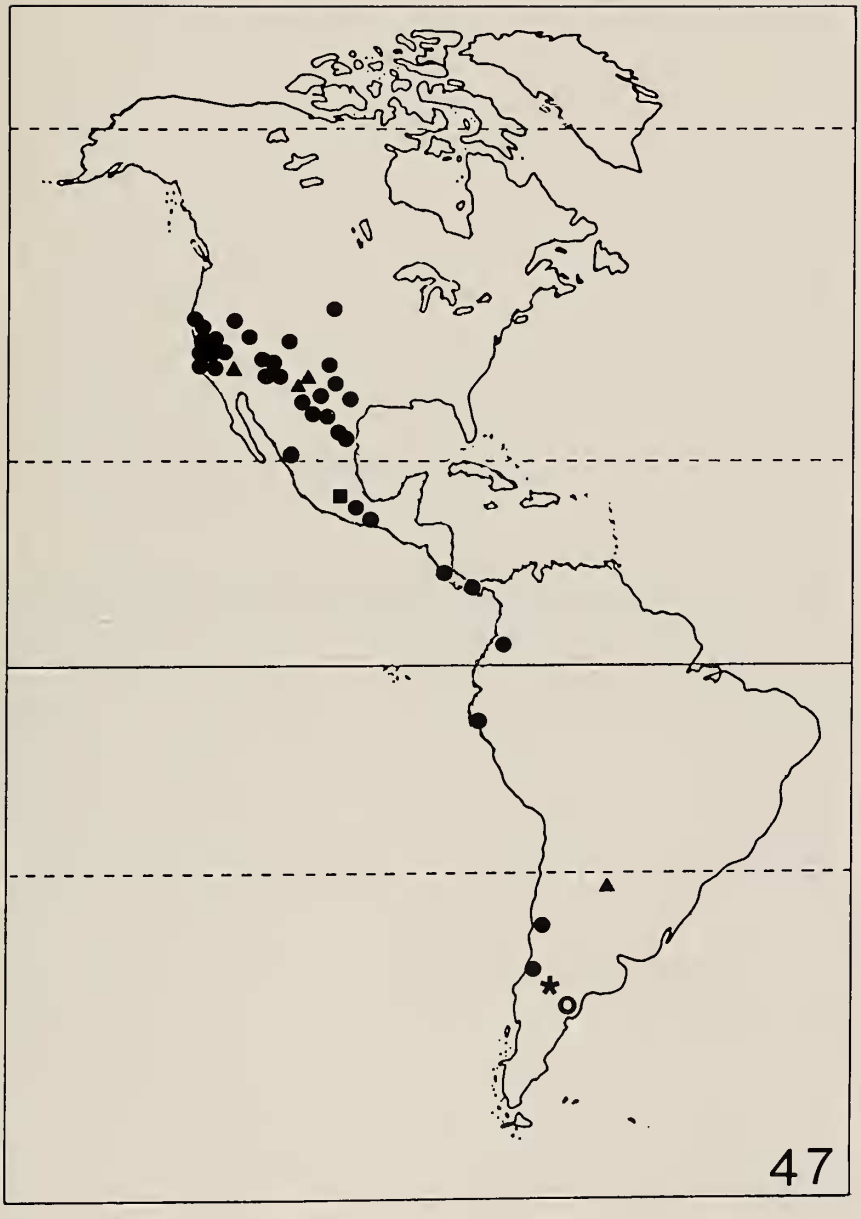

47

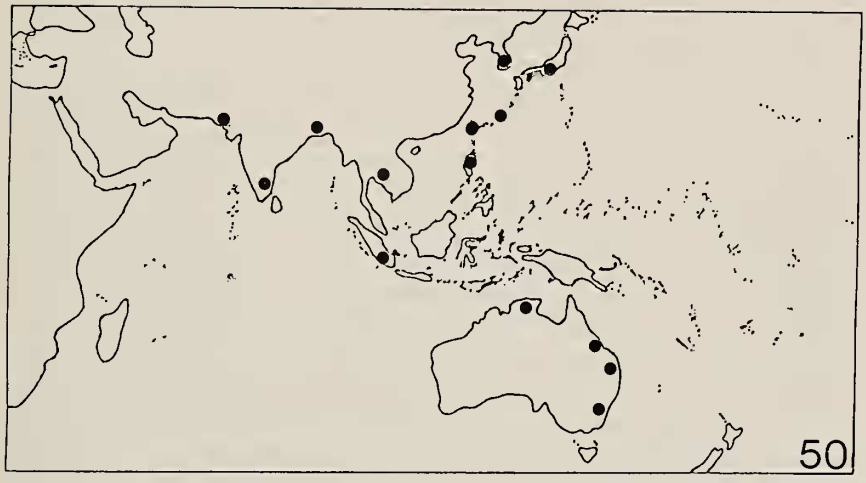
Fig. 48: Distribution map for *D. aethiops* (■) and *D. sinoposus* (●).

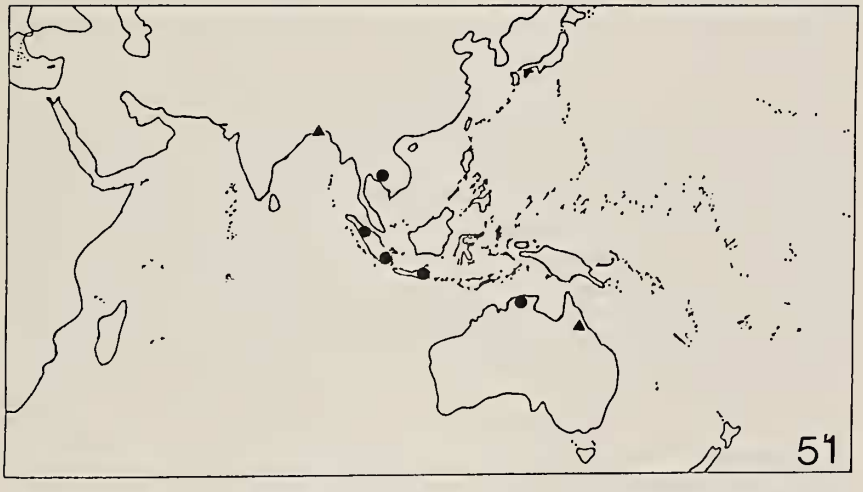

48

Fig. 49: Distribution map for *D. septemmaculatus*.


49

Fig. 50: Distribution map for *D. pelochloris.*
Fig. 51: Distribution map for *D. flexus* (●) and *D. tenuiforceps* (▲).


50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Chapter VI. Phylogeny

A phylogenetic analysis of the species in the genus *Dicrotendipes* was performed utilizing a standard Hennigian cladistic analysis as described by Hennig (1966), Ross (1974) and Wiley (1981).

Saether (1977) provided a cladistic analysis of the genera of the tribe Chironomini, which includes *Dicrotendipes*. He proposed that one synapomorphy, the presence of microtrichia on the well-developed female genitalic apodeme lobe, delimited a group of genera (*Dicrotendipes, Chironomus, Glyptotendipes, Kiefferulus* and *Einfeldia*), with the genera *Nilodorum* and *Goeldichironomus* as their sister group. However, Saether used the species *Nilodorum devineyae* Beck as the representative of *Nilodorum* in his analysis; this species is actually a *Goeldichironomus* (Pinder & Reiss 1983). Saether's "*Goeldichironomus-Nilodorum*" sister-group is actually only *Goeldichironomus*. Similarities in the larvae of *Kiefferulus* and *Nilodorum* led me to believe that *Nilodorum* should actually be included with the same group as *Dicrotendipes, Chironomus, Einfeldia, Kiefferulus,* and *Glyptotendipes*. Through the kindness of Dr. L. Hare, females of "true" *Nilodorum* sensu Pinder & Reiss (1983) (see Ashe et al. 1987:54 for a discussion on the taxonomic status of *Nilodorum*) were made available. *Nilodorum* does possess a well-developed apodeme lobe with numerous well-developed microtrichia, and thus joins the group of genera including *Dicrotendipes, Chironomus, Einfeldia, Glyptotendipes* and *Kiefferulus* (hereafter called the "*Chironomus* group").

Methods

Only 27 species known in all 3 life stages were included in the analysis. This was necessary because in many cases the apomorphy or apomorphies used to delimit lineages was/were present only in one life stage. It is often impossible to identify *Dicrotendipes* to species using only one life stage. This often necessitates rearing larvae through the pupal stage to the adult stage to correctly identify some species. Species descriptions from the literature were not used, because descriptions were incomplete. Many species are not known in all 3 life stages. The *D. californicus* species complex and the *D. lucifer* complex were treated as single taxa, leaving a total of 25 taxa to be analyzed. The 25 species used in the cladistic analysis were (abbreviations used for the species in Fig. 52 are given in brackets): *D. californicus* [CALF], *D. candidibasis* [CAND], *D. conjunctus* [CONJ], *D. cumberlandensis* [CUMB], *D. flexus* [FLEX], *D. fumidus* [FUMI], *D. fusconotatus* [FUSC], *D. jonmartini* [JONM], *D. kribiicola* [KRIB], *D. leucoscelis*

[LEUC], *D. lobiger* [LOBR], *D. lobus* [LOBS], *D. lucifer* [LUCI], *D. modestus* [MODS], *D. neomodestus* [NEOM], *D. nervosus* [NERV], *D. notatus* [NOTA], *D. pallidicornis* [PALL], *D. pelochloris* [PELO], *D. pseudoconjunctus* [PSEU], *D. sarinae* [SARI], *D. septemmaculatus* [SEPT], *D. sudanicus* [SUDA], *D. thanatogratus* [THAN] and *D. tritomus* [TRIT].

Taxa were grouped together on the basis of shared derived characters, termed synapomorphies. The polarity of character states (derived or apomorphic and ancestral or plesiomorphic) was determined by outgroup analysis. If a character existed in a similar state in both the ingroup (the group being analyzed, in this case *Dicrotendipes*) and the outgroup (the *Chironomus* group), that character state was termed plesiomorphic and was not used in the analysis. Symplesiomorphies (shared ancestral character states) are not used because they do not offer phylogenetic information as it applies to the ingroup. Only synapomorphies indicate that taxa may share a direct common ancestor. Symplesiomorphies can be synapomorphies at a different level of universality (Wiley 1981). The character state "female apodeme lobe well developed with numerous microtrichia" is symplesiomorphic for *Dicrotendipes* in relation to the *Chironomus* group. However, it is a synapomorphy for the *Chironomus* group in relation to the tribe Chironomini.

Saether (1977, 1979, 1983, 1986) has postulated that underlying synapomorphies (homoiologous characters of Hennig (1966:17); "the inherited capacity to develop parallel similarities" (Saether 1986:5)) are useful in cladistic analyses, a viewpoint condemned by Farris (1985). Saether (1986) discusses underlying synapomorphies again. I have not used underlying synapomorphies as characters in my cladistic analysis. A problem inherent in using underlying synapomorphies as characters in a cladistic analysis is that one could justify any grouping one desires by declaring any sporadically occurring character state as an underlying synapomorphy. Underlying synapomorphies may provide additional evidence to support hypotheses based on other synapomorphies, but cannot be used as the sole evidence to support an hypothesis.

The outgroup used in the analysis was the *Chironomus* group. Because of taxonomic uncertainty and probable polyphyletic lineages, it was not possible to select a single genus as an outgroup. All of these genera are in great need of revision.

Results and Discussion

The characters and character states used to construct a hypothetical phylogeny of *Dicrotendipes* species known in the adult, pupal and larval

stages are listed below. Furcations in the cladogram (Fig. 52) are indicated by upper case letters; numbers refer to apomorphies (those marked with an * have apparently arisen more than once in different lineages); lower case letters on the tree refer to losses, reversals, possible underlying synapomorphies, or symplesiomorphies and are placed on the tree only for reference purposes and were not used as characters in the cladistic analysis. In the list, lower case letters in parentheses indicate (a) = apomorphic, derived, and (p) = plesiomorphic, ancestral; upper case letters in brackets: [A] = adult character, [P] = pupal character, [L] = larval character.

The first 4 apomorphies listed are synapomorphous for the genus.

1. Pecten epipharyngis with less than 15 lobes (a); more than 15 lobes (p) [L].
2. Ventromental plate ratio less than 2.5 (a); more than 2.5 (p) [L].
3. Thoracic horn base with 2 tracheal bundles (a); 1 tracheal bundle (p) [P].
4. Sternite VI with ventral accessory setae (a); without ventral accessory setae (p) [A].

Saether (1977: Fig. 62) utilized the short, squat larval ventromental plates as his Trend 26 to separate *Dicrotendipes* from the genera *Chironomus, Kiefferulus, Glyptotendipes* and *Einfeldia.* This trend corresponds to apomorphy 2 in this cladistic analysis. Apomorphies 3 and 4 are apparently secondarily lost (reversals have taken place) in several species. The 2 tracheal bundles of the thoracic horn are partially joined by a narrow "bridge" of tracheoles in several species, and in at least 2 species only 1 tracheal bundle is present. Both of these conditions can vary from one side to the other in the same specimen. The ventral accessory setae on S VI have apparently been lost in the *californicus* complex and the *septemmaculatus* group. This apparent lack of setae may be a result of the small sample examined in the *septemmaculatus* group; it is also possible that some populations of a single species lack these setae. This last situation is apparent in several other species (*D. candidibasis, D. lobiger, D. modestus*). However, I have examined hundreds of specimens of the *californicus* complex and have never observed ventral accessory setae on them.

A 5. Acrostichal setal number reduced (a); normal (p) [A].

6. Frontal apotome with large ventral pit present (a); frontoclypeal apotome with large ventral pit present (p) [L].
7. Superior volsella without heavily sclerotized apical projection (a); with heavily sclerotized apical projection (p) [A].

a. S III with needlelike setae [P].

This furcation separates *D. lobiger* from the remaining species in the genus. The presence of a frontoclypeal apotome is plesiomorphous through-

out the Chironominae and apparently in the sister-group, the Orthocladiinae (Cranston, et al. 1983). The presence of a large ventral pit may indicate that *Einfeldia* species group A of Pinder & Reiss (1983) may be the "closest" sister-group to *Dicrotendipes*. *Einfeldia* is in drastic need of revision and is probably polyphyletic.

The needlelike setae on pupal S III are also found in the *D. modestus* group (furcation U), and in some species in at least one genus in the outgroup, *Kiefferulus*. *Kiefferulus* is also in need of revision. This character may be an underlying synapomorphy for the group of genera closely related to *Dicrotendipes*.

B 8. Frontal apotome with frontal process (a); frontal apotome with large ventral pit (p) [L].
9. Posterior margin of T V with 2 groups of hooklets (a); without hooklets (p) [P].
37. Shagreen on T VI broadly V-shaped (a); shagreen quadrilateral (p) [P].

Furcations A and B define the 3 main groups (I, II and III, Fig. 52) of species in the genus based on larval and pupal characters. Although other genera in the outgroup have larvae which also possess frontal or frontoclypeal apotomes with variously sized ventral pits, those present in *Dicrotendipes* are shaped differently and are often located in slightly different areas. The presence of hooklets at the posterior margin of T V is unique among the group of genera.

C*10. Mentum with 6th tooth fused/appressed to 5th (a); mentum without fused/appressed teeth (p) [L].
11. Superior volsella digitiform with ventrally directed membranous apex (a); digitiform without membranous apex (p) [A].
b. T IX with dorsal ovoid area [A].

Apomorphy 10 defines the *leucoscelis*-group. A somewhat similar mental appression/fusion occurs in 2 Nearctic members of the *nervosus* group.

Apomorphy 11 is distinctive for the *conjunctus*-group.

The dorsal ovoid area on T IX is a symplesiomorphy shared with many species of *Chironomus, Einfeldia* and *Kiefferulus*. Its presence on the cladogram is only for reference purposes. In addition to the 3 species of the *conjunctus* group, this character state is also found in *D. pelochloris* in the *pelochloris* group. It occurs sporadically throughout the *Chironomus* group.

D 12. Acrostichal setae absent (a); present (p) [A].
13. Inferior volsella with extremely wide apex (a); normal apex (p) [A].
c. Loss of hooklets on posterior margin of T V [P].

Apomorphies 12 and 13 are autapomorphies for *D. cumberlandensis,* which has apparently undergone a reversal with respect to the posterior hooklets on T V.

E 14. Less than 30 ventromental striae (a); more than 30 striae (p) [L].

15. Superior volsella strongly arched mediad (a); weakly arched or almost straight (p) [A].

d. Palmate sensilla chaetica present on hind metatarsus [A].

Apomorphies 14 and 15 are autapomorphies for *D. pseudoconjunctus.* This species is one of 2 species known outside of the Neotropical region in which palmate sensilla chaetica are present on the hind metatarsus of the male. These sensilla are also present in males of *Chironomus, Einfeldia, Kiefferulus* and *Nilodorum.* Their presence may be an underlying synapomorphy for the "*Chironomus* group." More data are needed.

F*16. Head capsule with grainy integument (a); without grainy integument (p) [L].

17. Superior volsella stout, with expanded apex (a); superior volsella digitiform (p) [A].

18. Anal point wide and strongly deflexed (a); anal point normal (p) [A].

Furcation F splits the *leucoscelis* and *jonmartini* groups from the *pelochloris* group.

G 19. Mentum with 6th, 5th and 4th lateral teeth fused/appressed (a); with only 6th and 5th lateral teeth fused/appressed (p) [L].

e. Palmate sensilla chaetica present on hind metatarsus [A].

f. T IX with dorsal ovoid area [A].

g. Loss of spines on posterior margin of T V [P].

Apomorphy 19 is an autapomorphy for *D. kribiicola.* Apparently 3 reversals have taken place with *D. pelochloris.* It and *D. pseudoconjunctus* possess palmate sensilla chaetica on the male hind metatarsus (see above). The dorsal ovoid area on T IX is also found on the *conjunctus* group and in the outgroup, where it occurs sporadically. *D. pelochloris* has apparently lost the posterior hooklets on T V.

H 20. Inferior volsella with membranous dorsal extension (a); without (p) [A].

I*21. Posterior margin of labral sclerite 1 with low tubercles (a); labral sclerite 1 smooth (p) [L].

*22. T VIII with 4 lateral lamellar setae (a); with 5 setae (p) [P].

23. T V hooklets in continuous row (a); in 2 groups (p) [P].

24. Frontal apotome with reduced ventral pit (a); with large ventral pit (p) [L].

h. Mentum normal.

Apomorphy 21 is autapomorphic (within the *leucoscelis* group) for *D. notatus.* This character state is also found in the *modestus-fumidus* groups.

Apomorphies 22–24 define the *jonmartini* group. Placement of this group is somewhat arbitrary, and is based mainly on the assumption that the 2 posterior groups of hooklets on T V transformed to the single band found in this group, and that the large frontal pit has been reduced to the faint, wide frontal pit found in *jonmartini* and *sarinae.* Based on superior volsella morphology, the 2 unusual species with median volsellae (*D. balciunasi* and *D. lindae*) may belong here, but without the immature stages it is not possible to accurately place them.

I must also assume here that the apomorphic state of 4 lateral lamellar setae on T VIII has evolved twice in the genus, because the character state occurs in 2 different lineages. All other species with 4 setae also possess a frontal projection, sometimes surrounded by a pit. This pit is not similar to, and probably not homologous to, the weak pit found in the *jonmartini* group. I believe it is more likely that the pupa would lose a seta and add a few posterior hooklets on T V (as in the *jonmartini* group), than for the posterior band of hooklets to have arisen twice within the genus.

The presence of a membranous dorsal extension (apomorphy 20), similar to that found on the Palaearctic *D. notatus,* may ally the *jonmartini* group with the *leucoscelis* group. Both groups also share the larval head capsule with a grainy integument, a character which has arisen at least 2 other times in the genus (*fumidus* and the *californicus* complex). Placement of the *jonmartini* group is to be considered tentative. It is also possible that the *jonmartini* group may be more closely allied with the *conjunctus* group, for both groups are exclusively Australian. More data are needed, as the *jonmartini-sarinae* sample size was small (n = 6 larvae and 3 pupae).

J 25. Superior volsella pediform, apex directed mediad (a); superior volsella digitiform (p) [A].

26. Less than 30 ventromental striae (a); more than 30 striae (p) [L].

Apomorphies 25 and 26 are autapomorphies for *D. jonmartini* and *D. sarinae,* respectively.

K*27. T VIII with 4 lateral lamellar setae (a); with 5 setae (p) [P].

28. Anal lobe with shagreen (a); without shagreen (p) [P].

29. Wings with spots (a); wings immaculate (p) [A].

30. Apex of inferior volsella deeply bifid (a); apex clubbed,emarginate-cordiform (p) [A].

31. Superior volsella mostly bare, long cylindrical, curved mediad, with moderately sclerotized apex (a); superior volsella digitiform (p) [A].

i. Loss of S VI ventral accessory setae [A].

Apomorphies 28–31 define the *septemmaculatus* group. I have not observed S VI ventral accessory setae on any members of this group. The

superior volsellar type is unique to this group. Furcations L, M and N split the group into the 4 species whose immature stages are known.

L*32. Mentum with some lateral teeth fused (a); mentum without fusions (p) [L].

j. More than 50 ventromental striae [L].

M 33. Hypopygium with accessory lobes (a); without lobes (p) [A].

N*34. Mandible with lateral teeth modifications (a); without modifications (p) [L].

35. Wing with clouds along veins (a); wing with spots (p) [A].

Apomorphies 32–35 are autapomorphies for species within the *septemmaculatus* group.

O*36. Posterior margin of labral sclerite 1 with low tubercles (a); labral sclerite 1 smooth (p) [L].

38. Superior volsella cylindrical, with membranous apex (a); superior volsella cylindrical, without membranous apex (p) [A].

39. T V with separate anterolateral shagreen areas (a); without separate areas (p) [P].

Furcation 0 is the splitting point for the 2 main lineages with 4 lateral setae on pupal T VIII (with the exception of the *jonmartini* group, which is apparently more closely related to the *conjunctus-leucoscelis* groups). This refers only to those species whose larvae are known. The Neotropical forms with bifid inferior volsellae may also belong here, for the pupae of the two known species have 4 lateral setae on T VIII and the shagreen on T VI is broadly V-shaped. These Neotropical species probably are a sister group to the *nervosus* group.

P*40. 1st and 2nd lateral teeth of mentum fused (a); not fused (p) [L].

41. Proximal inner tooth of mandible modified (a); unmodified (p) [L].

Q 42. Superior volsella deltoid (a); superior volsella cylindrical with membranous apex (p) [A].

Furcations P and Q are to be considered arbitrary, due to the presence of *D. lobus*. This species is difficult to place due to its unusual superior volsella. The V-shaped shagreen on T VI indicates that this species belongs with the *nervosus* group. I have placed *D. lobus* closer to *D. candidibasis* and *D. flexus* (furcation Q) because these 3 species share an apomorphy, the fusion of the 1st and 2nd lateral teeth of the mentum. However, this character is apparently homoplasious, for it appears again in the *modestus* group (*D. neomodestus*) and in the *septemmaculatus* group. It does appear that the fusion in *lobus, candidibasis* and *flexus* is not similar or homologous to the fusion found in the other groups; the fusion of the teeth is more complete in *lobus,* etc. Obviously, more data are needed here.

R 43. Mentum with median tooth sunken well beneath level of 1st lateral teeth (a); median tooth subequal to 1st lateral teeth (p) [L].

44. Wing with bands/spots (a); wing immaculate (p) [A].
*45. Apodeme lobe with few, weak microtrichia (a); with numerous, well developed microtrichia (p) [A].
46. Cephalic tubercles minute (a); well developed (p) [P].
S 47. Superior volsella rotated 90° around longitudinal axis (a); not rotated (p) [A].

Apomorphies 43–47 are autapomorphies for species within the *nervosus* group; 43–45 define *candidibasis,* 46 *flexus,* 47 the *lucifer* complex.

T 48. Superior volsella cylindrical with lightly sclerotized apex (a); with membranous apex (p) [A].
*49. Head capsule with grainy integument (a); without grainy integument (p) [L].
*k. S III with needlelike setae [P].
50. Apotome with small frontal pit surrounding frontal projection (a); with frontal projection only (p) [L].

Apomorphies 48 and 49 are apomorphic for *D. fumidus,* a species intermediate in characters between the *modestus* and *nervosus* groups. Apomorphy 50 is a synapomorphy for the *modestus* group. All species in the *modestus* group also have needlelike spines on pupal S III, a character also found in *D. lobiger* and in the genus *Kiefferulus.* Similar groups of spines are also found on at least one genus outside of the outgroup, *Cladopelma.* This character is not used in this analysis, and is placed on the cladogram for informational purposes only.

U*51. Apodeme lobe with few, weak microtrichia (a); with many, well developed microtrichia (p) [A].
52. Superior volsella pediform (a); cylindrical (p) [A].

Apomorphy 51 delimits the species *D. tritomus* in the *modestus* group. This species does not have a pediform superior volsella (apomorphy 52), but possesses a superior volsella somewhat similar to that of *D. nervosus.* However, closer inspection reveals that the volsellae of the 2 species are not similar (Epler 1987a). Larvae and pupae of *D. tritomus* are almost identical to *D. modestus,* and often are inseparable without associated adults.

V 53. Caudolateral spurs on T VIII located anterior to posterior corner (a); spurs located on posterior corner (p) [P].
*54. Head capsule with grainy integument (a); without grainy integument (p) [L].
*55. Anal lobe with shagreen (a); without shagreen (p) [P].
56. Fewer than 20 ventromental striae (a); more than 20 ventromental striae (p) [L].
*57. 1st and 2nd lateral teeth of mentum fused (a); normal (p) [L].

Apomorphies 53 and 54 are apomorphies for the *D. californicus* complex.

Apomorphies 55 and 56 are autapomorphic for *D. thanatogratus*. Apomorphy 57, a homoplasy, is autapomorphic within the *modestus* group for *D. neomodestus*. There is no unambiguous way to delineate the cladogenesis of these species with current data.

The cladistic analysis indicates that the species fall into the following 9 groups (denoted by numbers above the species names in the cladogram, Fig. 52): 1) *lobiger* group: *lobiger;* 2) *conjunctus* group: *conjunctus, cumberlandensis, pseudoconjunctus;* 3) *pelochloris* group: *kribiicola, pelochloris;* 4) *leucoscelis* group: *leucoscelis, notatus;* 5) *jonmartini* group: *jonmartini, sarinae;* 6) *septemmaculatus* group: *fusconotatus, pallidicornis, septemmaculatus, sudanicus;* 7) *nervosus* group: *candidibasis, flexus, lobus, lucifer, nervosus;* 8) *fumidus* group: *fumidus;* 9) *modestus* group: *californicus, tritomus, modestus, neomodestus, thanatogratus.*

Epler (1987c) used the computer program PAUP (Swofford 1985) as a supplemental tool in phylogenetic analysis. The PAUP analysis basically agreed with the Hennigian cladistic analysis. PAUP constructs trees utilizing the Wagner method and a maximum parsimony algorithm, i.e., the tree with the fewest steps (character state transformations) is the most parsimonious. If one assumes that the Hennigian cladogram that invokes the smallest number of hypotheses to deal with homoplasy (convergence/parallelism: the occurrence of similar character states in species which do not share an immediate common ancestor possessing that character state) is the most parsimonious, trees constructed from the same data should yield similar results (Swofford 1985). Some workers contend that the use of Wagner trees and computer programs reduces bias and promotes objectivity (Farris 1985; see also Saether 1986). However, one begins to introduce bias when the characters for the analysis are chosen (all the potential characters of an organism are not used), and, as Saether (1986:3) stated: "there is no biological evidence that minimum length trees or equally parsimonious trees are most in accordance with the "true" tree." To invoke strict parsimony to explain evolutionary relationships could mean that evolution as a process "knows" the shortest path to take to reach a given goal. Hennig (1966) did not advocate the use of parsimony to resolve conflicts in a cladogram, but instead recommended that the full set of characters be reexamined to determine if characters had been misinterpreted. I believe that it is the taxonomic precision of the worker and his/her knowledge of the group(s) in question that can decide the usefulness and "correctness" of the hypothesized cladogram(s).

The 3 major lineages (I, II and III in Fig. 52) could be considered subgenera. However, these are based chiefly on characters of the immature stages (mainly the larval frontal/frontoclypeal apotome). It is impossible in many

cases to place adults in subgenera, and the majority of *Dicrotendipes* species are known only as adults. For this reason I am not establishing subgenera at this time.

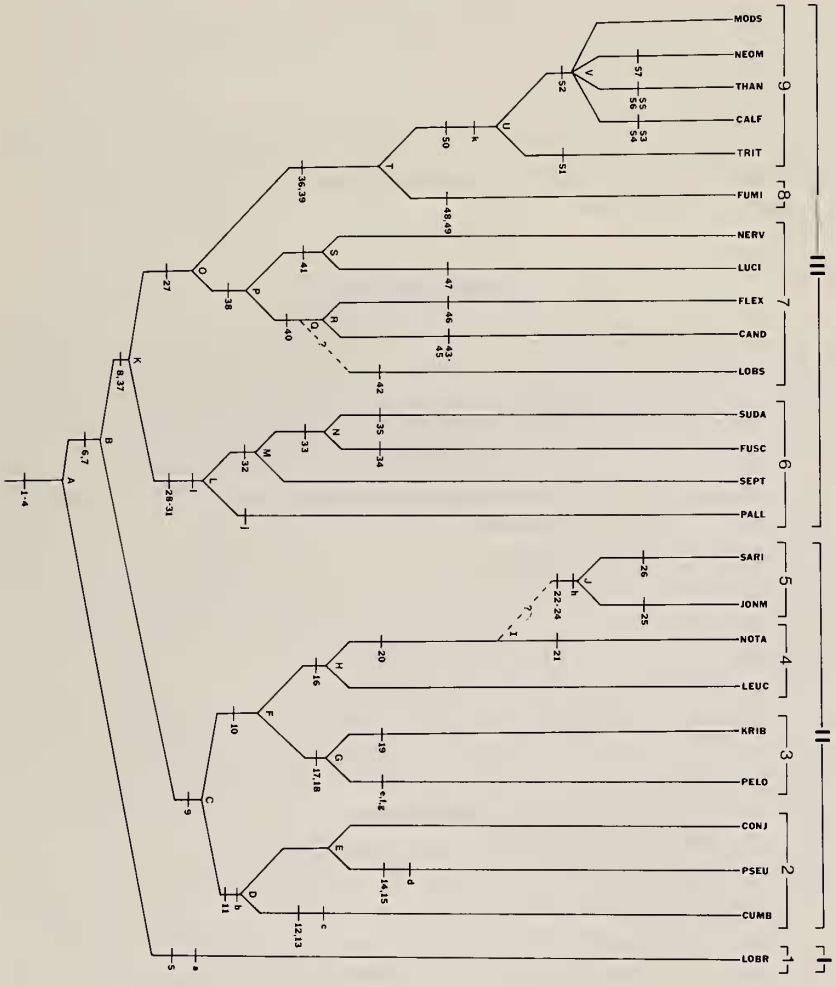

Fig. 52: Cladogram depicting the hypothesized relationships within *Dicrotendipes*.

It is possible to subjectively place some species in some species groups. *Dicrotendipes adnilus, D. sinoposus* and the other 3 members of the *californicus* group (*D. embalsensis, D. obrienorum, D. pellegriniensis*) belong in the *modestus* group; *D. peringueyanus* to the *septemmaculatus* group; *D. balciunasi* and D. *lindae* to the *jonmartini* group; *D. aethiops, D. freemani, D. chambiensis, D. inouei* and *D. tamaviridis* in the *nervosus* group. The majority of the Amazonian species described in Chapter III probably represent another lineage near or derived from the *nervosus* group, based on the pupal characters of *D. fittkaui* and *D. soccus.*

The discovery of the presently unknown immature stages of most *Dicrotendipes* species, especially the Afrotropical and Neotropical species, and revisions of the genera in the *Chironomus* group will greatly improve the taxonomy of the genus.

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Appendix 1

List of recognized species' names in the genus *Dicrotendipes,* and their distribution. (?) indicates a questionable species name. Abbreviations for zoogeographical regions are as follows: NE = Nearctic, NT = Neotropical, PA = Palaearctic, AF = Afrotropical, OR = Oriental, AU = Australian, OC = Oceanian.

D. adnilus Epler NE
D. aethiops (Townes) NE
D. amazonicus Epler NT
D. alsinensis (Paggi) NT
D. arcistylus Guha, Das, Chaudhuri & Choudhuri OR
D. balciunasi Epler AU
D. bilobatus Kieffer AU
D. botaurus (Townes) NE
D. bredoi (Goetghebuer) AF
D. californicus (Johannsen) NE, NT
D. candidibasis (Edwards) OC
D. canitibialis Guha, Das, Chaudhuri & Choudhuri OR
D. chambiensis (Goetghebuer) AF
D. collarti (Goetghebuer) AF
D. conjunctus (Walker) AU
D. cordatus Kieffer AF
D. crypticus Epler NE, NT?
D. cumberlandensis Epler AU
D. dasylabidus Epler NT
D. demissus Epler NT
D. ealae (Freeman) AF
D. embalsensis Paggi NT
D. fittkaui Epler NT
D. flexus (Johannsen) OR, AU
D. freemani Epler AF
D. fumidus (Johannsen) NE
D. fusciforceps (Kieffer) (?) PA
D. fusconotatus (Kieffer) AF, PA
D. inouei Hashimoto PA
D. jobetus Epler AU
D. jonmartini Epler AU
D. kribiicola (Kieffer) AF
D. leei (Freeman) AU
D. leucolabis Kieffer AF
D. leucoscelis (Townes) NE
D. lindae Epler AU
D. lobiger (Kieffer) NE, PA
D. lobus (Beck) NE
D. lucifer (Johannsen) NE
D. milleri (Townes) NE
D. modestus (Say) NE, PA
D. neomodestus (Malloch) NE
D. nervosus (Staeger) NE, PA
D. nestori Paggi NT
D. nigrolineatus (Freeman) AF
D. notatus (Meigen) PA
D. obrienorum Epler NT
D. palearivillosus Epler NT
D. pallidicornis Goetghebuer PA
D. paradasylabidus Epler NT
D. paterjohni Epler NT
D. pellegriniensis Paggi NT
D. pelochloris (Kieffer) OR, PA, AU
D. peringueyanus Kieffer AF, PA
D. pseudoconjunctus Epler AU
D. radinovskyi Epler NT
D. reissi Epler NT
D. sarinae Epler AU
D. schoutedeni (Goetghebuer) AF
D. semiviridis (Kieffer) (?) OR
D. septemmaculatus (Becker) PA, AF, OR, AU
D. simpsoni Epler NE
D. sinoposus Epler NT
D. soccus Epler NT
D. sudanicus (Freeman) AF
D. tamaviridis Sasa PA
D. taylori (Freeman) AU
D. tenuiforceps (Kieffer) OR, AU
D. thanatogratus Epler NE
D. tritomus (Kieffer) PA, NE
D. truncatus (Kieffer) (?) PA
D. venetus (Marcuzzi) (?) PA

Appendix 2

List of recent name changes and current name as recognized in this paper

Previous Name	Current Name
binotatus Kieffer, 1911 (*Chironomus*)	*D. freemani,* nom. nov.
figueroai Vargas, 1952 (*Tendipes* (*Limnochironomus*))	*D. aethiops* (Townes, 1945)
formosanus Kieffer, 1916 (*Dicrotendipes*)	*D. septemmaculatus* (Becker, 1908)
frontalis Kieffer, 1916 (*Dicrotendipes*)	*D. septemmaculatus* (Becker, 1908)
hirtitarsis Johannsen, 1932 (*Chironomus*)	*D. septemmaculatus* (Becker, 1908)
hoonsooi Ree, 1981 (*Kimius*)	*D. pelochloris* (Kieffer, 1912)
incurvus Sublette, 1964 (*Chironomus* (*Dicrotendipes*))	*D. tritomus* Kieffer, 1916
inferior Johannsen, 1932 (*Chironomus*)	*D. pelochloris* (Kieffer, 1912)
innisfailensis Freeman, 1961 (*Chironomus* (*Dicrotendipes*))	*D. tenuiforceps* (Kieffer, 1913)
loripes Guha & Chaudhuri, 1981 (*Xenochironomus*)	*D. pelochloris* (Kieffer, 1912)
melanocnemis Edwards, 1928 *(Chironomus)*	*D. candidibasis* (Edwards, 1924)
niveicauda Kieffer, 1921 (*Limnochironomus*)	*D. pelochloris* (Kieffer, 1912)
paxillus Guha, Chaud, & Nandi, 1982 (*Dicrotendipes*)	*Chironomus glauciventris* (Kieffer, 1912)
pulsus Walker, 1856 (*Chironomus*)	*D. modestus* (Say, 1823)
? *punctatipennis* Kieffer, 1910 *[Chironomus* (*Prochironomus*)]	*D. septemmaculatus* (Becker, 1908)
rajasthani Singh & Kulshrestha, 1977 (*Dicrotendipes*)	*D. septemmaculatus* (Becker, 1908)
socionotus Guha, Chaud. & Nandi, 1982 (*Dicrotendipes*)	*Chironomus* tainanus (Kieffer, 1912)
wirthi Freeman, 1961 (*Chironomus* (*Dicrotendipes*))	*D. pelochloris* (Kieffer, 1912)

The species *Dicrotendipes crispi* (Freeman, 1957), *D. multispinosus* (Freeman, 1957), *D. penicillatus* (Freeman, 1957) *D. regalis* (Goetghebuer, 1936) are no longer considered members of *Dicrotendipes,* and must be assigned to a new, as yet undescribed, genus.

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Synonyms in *italics,* new species in **boldface**